

## Chapter 6 - Overview of Proposed Sites and Technologies

This chapter provides a descriptive overview of the proposed sites for the ERGS facilities and the coal-based technologies proposed by the applicants. It also explains the site selection process and siting criteria used by the applicants to choose the proposed sites that were submitted in their CPCN application.

### Site Selection Process

The applicants state that the site selection process started with over 140 potential sites. The number of potential sites was further reduced through a process that evaluated the sites on various social, environmental, and technical/economic parameters that were embodied in 55 screening criteria, which were weighted according to their importance. Social issues captured in the criteria included public attitudes, current and future land use, need for land acquisition, and effects on property owners, and the general public. Examples of environmental issues included in the criteria are air and water quality, presence of wetlands and natural areas, and landfill capacity among others. Technical/economic aspects included in the criteria were availability of cooling water, proximity to railways, highways and transmission lines, physical site conditions, ease of construction, and adequacy of pre-existing conditions.

The primary site selection criteria used by the applicants to select the proposed coal generation locations focused on the criteria related to cooling water, fuel delivery, and electrical transmission. The ability to locate all three proposed units at one site as well as the potential re-use of existing infrastructure were also important considerations in the applicants' final selection of sites. Five possible sites, shown in Table 6-1, were closely compared in making the final selection.

**Table 6-1 Site alternatives compared in the applicants' final selection**

Site	County	Type	WEPCO – Controlled
North Oak Creek	Milwaukee	Brownfield	Yes
Pleasant Prairie	Kenosha	Brownfield	Yes
Haven	Sheboygan	Greenfield	Yes
Ozaukee	Ozaukee	Greenfield	No
Little Suamico	Oconto	Greenfield	No

The sites in Ozaukee and Oconto Counties were eliminated because of the increased cost and environmental impact to develop greenfield sites and acquire a substantial amount of land. Because of its irregular shape, the applicants state that acquisition of additional land may have been required to build the ERGS facilities on the Haven site and once-through cooling would not have been a viable option because the site is about 0.25 miles from Lake Michigan.

WEPCO's existing Pleasant Prairie Power Plant site would have been large enough to accommodate only the two SCPC units, not the third IGCC plant. Also, because of the site's distance from Lake Michigan, cooling towers would have been required, reducing the efficiency and overall output of the proposed facilities.

In reviewing the North OCPP site, the applicants identified other possible sites near the southern end of the WEPCO-owned property in Racine County that could also accommodate all three coal-based units and share the advantages of once-through cooling, and use of the existing transmission infrastructure and rail lines.

Although the sites would share the use of some of the common existing OCPP infrastructure such as the coal-handling equipment, rail lines and ash landfills, there are several ways in which the sites can be differentiated as alternative sites. These differences include: 1) having building footprints in different municipalities and counties resulting in different entities receiving shared-revenue payments if the ERGS proposal is approved, 2) separate service water discharge locations, and 3) significant differences in the amount of excavation required to build and safely operate the facilities.

A detailed description of the proposed sites and these differences are described below.

## **Proposed Sites**

Two site options (one of which has a variation) have been proposed by the applicants for the ERGS facilities. As described above, all of the sites are on WEPCO-owned property adjacent to the existing OCPP on the shore of Lake Michigan (see Figure 6-1). One of the sites is north of the existing OCPP, while the other alternatives are south of the existing OCPP. The existing plant is shown in the aerial photo in Figure 6-2. The North Site and South Site are located completely on WEPCO-owned property. The South Site-Exp is located mostly on WEPCO property, but extends onto what is currently a federally-owned shooting range. WEPCO has reached an agreement to secure the shooting range property in the event that the South Site-Exp is chosen by the Commission as the approved site for the ERGS facilities. The shooting range would be relocated to an area on the north side of Seven Mile Road east of the railroad corridor.

After the draft EIS was issued, WEPCO and the city of Oak Creek negotiated another site layout plan for use on the North Site. Some information regarding this new site layout was filed in WEPCO's direct testimony. Additional information and maps requested by PSC and DNR staff were provided in mid to late-June. This new site layout, the CUP Option, would also require use of a portion of the shooting range property. A more detailed description of the CUP Option layout and the potential environmental effects related to this layout are found in Chapter 12.

Detailed information about the local environment and potential community impacts related to building the facilities on the North and South Sites is found in Chapters 7 through 12.

Figure 6-1 Location map showing OCPP property in relation to the city of Oak Creek and northern Racine County

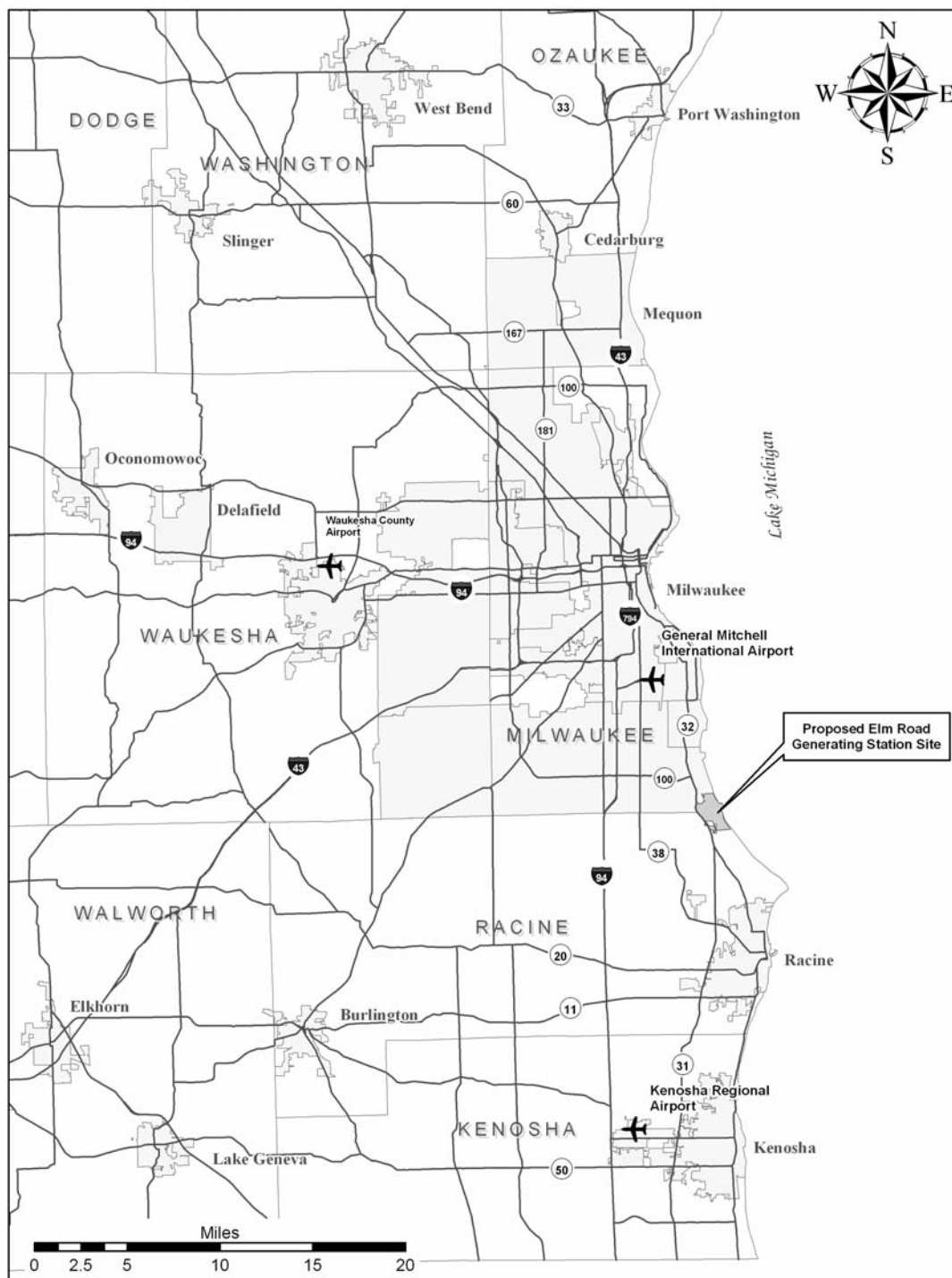
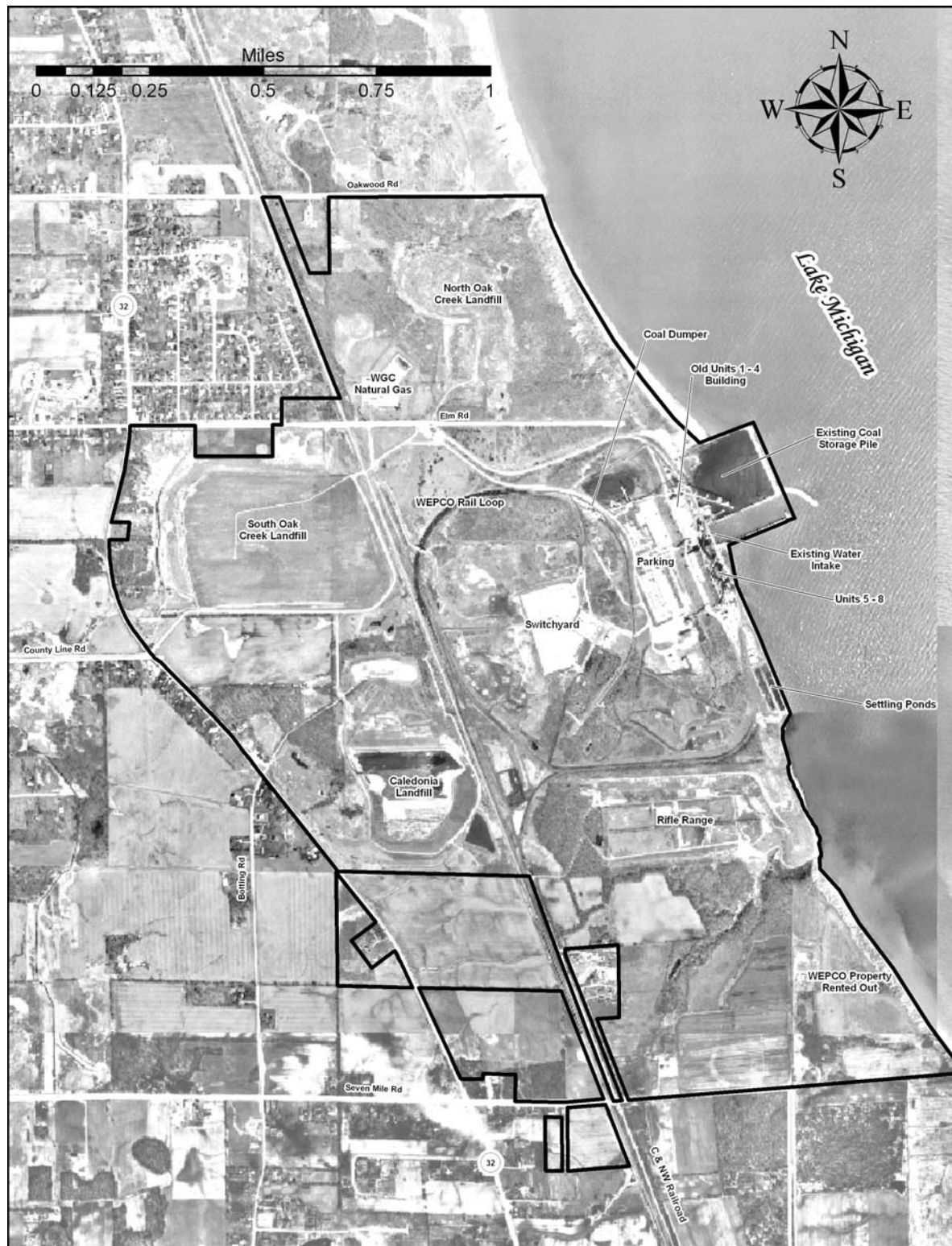


Figure 6-2 Aerial photo of existing OCPP site



## North Site

### Existing structures and land cover

The North Site is located on WEPCO's property in the city of Oak Creek in Milwaukee County, Wisconsin. This portion of the property is comprised of about 35 acres located along the Lake Michigan shoreline. A 100-foot bluff now parallels the lake shoreline and is present along the entire length of the proposed North Site. The southern half of the North Site currently consists of some previously graded lands and an access road that passes through a large ravine as it runs from the top of the bluff to the existing North OCPP building. The northern portion of the North Site includes a portion of the existing, closed North Oak Creek Ash Landfill. To the east of the bluff, depending on the location along the site, the site is relatively flat for about 100 to 350 feet leading to beach material and the lake. A large coal dock, created by filling in a portion of the lake near the former North OCPP units 1-4, is located southeast of the end of Elm Road. The natural features of the North Site are discussed in more detail in Chapters 8 and 10.

The location of the SCPC units on the North Site would be near the east end of Elm Road and about 0.25 miles north of the building that formerly housed the OCPP units 1-4. The proposed SCPC units would be located in Section 31, Township 5 North, and Range 23 East (T5N-R23E). The location for the IGCC unit is south of the SCPC units in the vicinity of the present North OCPP building. See Figure 6-2.

The existing operating South OCPP units lie south of the proposed IGCC location. This plant contains four coal-fired plants (units 5-8) and one combustion turbine (unit 9) which generate about 1,200 MW total. Unit 9 would be retired before operation of the first SCPC unit. At one time, the OCPP was a nine-unit 1,700 MW power plant, prior to the retirement of the North Oak Creek units. Units 3 and 4 were retired and substantially removed on April 1, 1988, and Units 1 and 2 were retired on December 31, 1989. The building for the former North Oak Creek units still remains because it supports coal handling and other facilities serving the remaining units. It would be demolished, however, to make way for the new plant. The larger features of the South Oak Creek plant are shown in Figure 6-2.

Figure 6-2 also shows an existing substation and switchyard that interconnects the plant to the American Transmission Company (ATC) electric transmission system. An existing rail line and track system for coal delivery connects to interstate railroad tracks running north and south parallel to the lake shore. Inside the upper portion of the train track is a relatively mature beech maple woodland (discussed in detail in Chapter 10) that appears to be the habitat for an endangered plant species as well as a beech forest community.

The coal unloading process currently requires the break-up of trains and creates local traffic congestion south of the site in Racine County. This problem and proposed solutions are discussed in detail in Chapter 11. Coal storage piles are located on the dock area which is a filled area in the lake present just south of the access road and another east of the car dumper near the rail track. Coal handling systems presently run from the dumper along the track to the storage piles and back to the currently operating boilers. A water intake system in Lake Michigan provides water for cooling and other process water for the existing OCPP units. The intake channel currently provides a means to accept delivery of coal, limestone, or other needed raw materials via barges or lake vessels for the existing units. Bottom ash from the boilers is temporarily stored on the coal dock, and fly ash not being utilized for other purposes is currently being landfilled in the only on-site operating landfill. This landfill, the Caledonia Landfill, is located in the southwestern portion of the property. Two closed landfills exist on the northwest end of the property south of Elm Road.

The proposed locations of the ERGS facilities are discussed below and in more detail later in this chapter. A more detailed discussion of the ash handling and landfills can be found in Chapter 9.

### **Proposed structures and land cover**

Generating station equipment would occupy about half of the site, and the balance would be areas that include access roads, storage buildings and open areas for electrical transmission line corridors. Detailed descriptions of the proposed SCPC and IGCC power plants and their auxiliary facilities are found later in this chapter. The proposed layout for the ERGS plant at the North Site is shown in Figure Vol. 2-1.

Conventional SCPC facilities are typically constructed on relatively flat sites. This allows for standardized designs that provide the most cost-effective means to complete engineering and construction work. If the elevation differs across the site, equipment arrangements, duct runs, piping locations and the ability to share common utilities for both SCPC units (such as coal handling, circulating water, and service water) becomes more difficult and the economics of a standardized design are lost. The units need to be at the base of the bluff to facilitate open-cycle cooling. Therefore, WEPCO and WE Power have proposed that the bluff be cut back to allow for the installation of these units.

The SCPC units would include air pollution control equipment buildings such as the selective catalytic reduction (SCR) facility, a new baghouse or high efficiency electrostatic precipitators, and wet scrubbers. The footprint for each generating unit would be about 300 feet wide and about 1,200 feet long (perpendicular to the lakeshore), covering about 8.3 acres.

The IGCC unit would be located along the shoreline at the site of the old North OCPP building, and its related buildings would extend westward from there, with most of them placed on the north and east side of the existing rail loop. Both the combined-cycle (CC) facility and air separation unit (ASU) of the IGCC would be at the base of the bluff to facilitate open-cycle cooling with lake water.

Some of the auxiliary facilities for the existing OCPP units would be the same, while others would need to be changed. The substation and switchyard would remain where they are, but a substation expansion is proposed. The existing rail loop would be widened inward to accommodate additional tracks with new dumper equipment, resulting in a loss of some of the mature woodland inside the loop. The coal conveyance facilities would be relocated to accommodate new coal piles in the northwest portion of the property, north of the rail loop. The new coal piles would occupy approximately 55 acres of land with a footprint of approximately 1,425 by 1,650 feet, exclusive of the various conveyors.

The existing coal dock could accommodate barge coal delivery and would be used for barge limestone delivery and storage. The limestone handling and storage system would occupy approximately 13 acres of the existing coal dock and have a footprint of approximately 750 by 750 feet. The current docking facilities may be expanded to handle larger coal barges and ships. A new ship unloading facility, including a breakwall, is proposed for east of the existing dock in the lake. A proposed new expansion of the existing dock would require filling in additional lake area for a distance of about 500 to the north of the existing dock. Some materials handling facilities would be located on the new fill. A new intake structure would be installed approximately 3,500 to 9,000 feet out into the lake with bored tunnels that would contain the pipeline for carrying water to the new ERGS and existing OCPP facilities. No new landfills would be created.

A potential site for a commercially-owned wallboard plant has been set aside south of OCPP units 5-8 and north of and parallel to a federally-owned shooting range which is discussed in more detail in Chapters 9, 11, and 12. The potential for construction of a wallboard plant is discussed in more detail later in this chapter and in Chapters 9 and 10.<sup>71</sup>

## **South Site**

### **Existing structures and land cover**

The proposed South Site is in the northwest quarter of Section 6 in T4N-R23E, in the town of Caledonia in Racine County, Wisconsin. WEPCO owns the land, which is south of the currently operating South OCPP units. The 60-acre portion of the site proposed for the SCPC units is approximately 1,300 feet wide. It lies south of the county line and north of the shooting range property. The site extends, on average, about 2,000 feet west of the Lake Michigan shoreline to a point near the railroad tracks. A 100-foot bluff parallels the lake shoreline along the entire length of the South Site. East of the bluff, the shoreline is relatively flat for about 300 to 350 feet to the lake. There are existing settling ponds south of the operating OCPP power plant units on this part of the property. At the top of the bluff, the land is also fairly level. It supports a few buildings and roads. An area designated as an “isolated natural resource area” (INRA) is at the west end of the proposed IGCC plant location east of the rail loop. The location of and impacts to this and other INRAs are discussed in Chapter 10.

### **Proposed structures and land cover**

Figure Vol. 2-2 shows the South Site layout. Similar to the North Site, the facility would be entirely located on WEPCO-owned property. Again, as at the North Site, construction of the SCPC and IGCC units on the South Site would require extensive earthwork to create a flat site large enough for all the plant equipment that needs to be placed at or close to lake level. The IGCC buildings for the South Site would be aligned east to west and perpendicular to the lakeshore in a relatively tight space, adjacent to the shooting range property line and extending into the INRA. The proposed IGCC facility would be directly south of the SCPC units. The air separation unit, sulfur recovery unit, sulfuric acid storage tanks, and waste water treatment facilities would be located within the area of the INRA.

The same road and rail loop construction would be needed for the South Site as for the North Site. The shape and dimensions of the coal storage area would differ slightly from that planned for the North Site, but it would be stored at the same location. The coal conveyor system would be routed differently to deliver coal to each of the new units on the South Site. The wastewater discharge channel would be located near the southeast corner of the SCPC units. The same expansion of the transmission system would be necessary regardless of site. The same ash landfills would be used but the on-site haul roads would be adapted as needed.

The potential site for the commercially-owned wallboard plant would be shifted for the South Site to a northern location along the top of the bluff at a point near the east end of the existing Elm Road and next to the proposed coal piles.

---

<sup>71</sup> The originally proposed wallboard plant site was at the current site of the South Oak Creek Landfill. This location would have required excavation and reclamation of at least some of the landfill ash. WEPCO has since revised the most likely wallboard plant locations for the three sites so that it would be built closer to the lakeshore rather than near the South Oak Creek Landfill.

## South Site - Exp

### Existing structures and land cover

The South Site-Exp, also in the northwest quarter of Section 6, T4N-R23E, includes land owned by WEPCO south of the operating South OCPP units plus the land parcel further to the south that is owned by the federal government and is currently used as a shooting range. The WEPCO land available south of units 5-8 is about 60 acres, and most of it would be used for the SCPC units, laid out in the same manner as for the South Site. The shooting range property is about 70 acres in size. If this land could be purchased, it would allow the proposed IGCC facility to be expanded in acreage and sited closer to Lake Michigan.

WEPCO has met with the Department of Military Affairs (DMA) to discuss the shooting range property. According to WEPCO, the DMA has been supportive of a land swap or purchase. WEPCO and the DMA have reached an agreement. Based on discussions at the time of this EIS, WEPCO indicates that it would likely obtain the site in 2004, in time to begin construction of the IGCC facility.

The 100-foot tall bluff along the lake shore continues along the entire length of the South Site and the South Site-Exp. The site is bordered on the east by Lake Michigan and on the west by the bluff. East of the bluff, and on the WEPCO-owned property, the land is relatively flat for about 300 to 350 feet to the lake. Along the shooting range property, and to the south of it, the bluff essentially forms the lakeshore, with some artificial bluff stabilization work in place. A large wooded ravine is located just south of the shooting range on existing WEPCO-owned land. This ravine would not be used as part of the ERGS facilities site.

### Proposed structures and land cover

Similar to the South Site, use of the South Site-Exp option would require cutting into and leveling portions of the existing 100-foot tall bluff that parallels the lake shoreline. Figure Vol. 2-3 shows the site layout. While the SCPC units would be located in the same place, the South Site-Exp includes a different location for the IGCC facility, placing it south of the proposed SCPC unit sites, but closer to Lake Michigan and extending onto the shooting range property.

WEPCO prefers this site option to the other South Site arrangement for engineering and construction reasons. Use of this option would allow equipment that requires cooling water to be located closer to Lake Michigan without as much bluff removal. The IGCC equipment could also be expanded to a more accessible size and less tightly arranged. Potential impacts related to utilizing the shooting range property are discussed in Chapters 9, 10, and 11.

The coal piles for both the new bituminous and the currently used subbituminous coals would remain on the north portion of the existing OCPP site. A coal conveyor from the bituminous coal pile on the north portion of the site would be routed to deliver coal to the gasification building. The coal conveyor length would be similar to that needed for the South Site SCPC site layout. The rail loop would also be the same as for the South Site and the North Site. The transmission switchyard and rail loop would be the same as they would be for the South Site or the North Site.

The potential site for a commercially-owned wallboard plant would be at the same place as described and shown for the South Site.

## Proposed Coal Technologies

### Super critical pulverized coal (SCPC)

#### Description of the technology and plant components

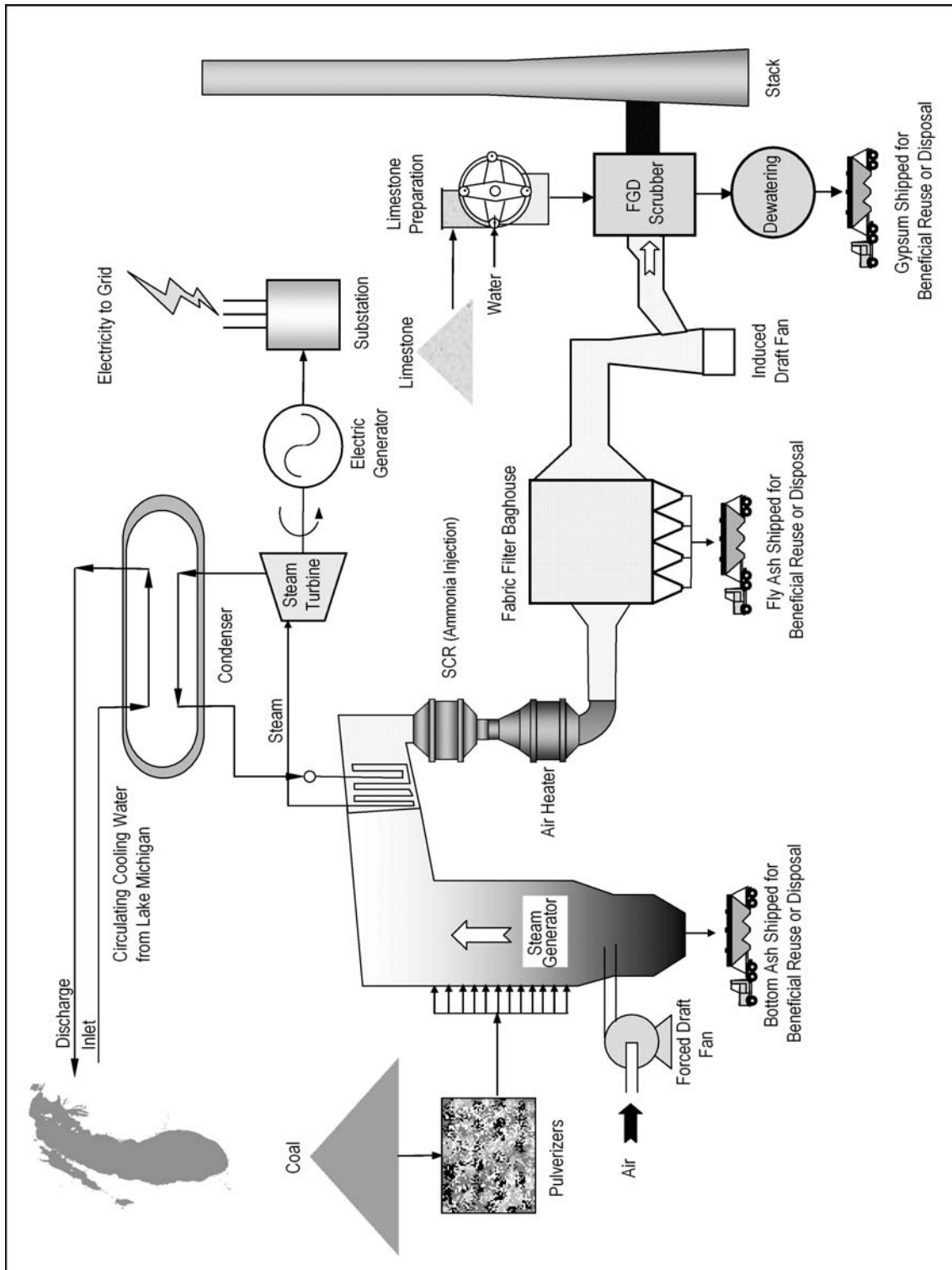
To generate electricity, conventional coal-fired power plants mix pulverized coal with hot air and inject the fine particles into a furnace lined with water-filled tubes. Steam from the boiling water spins a steam turbine generator to produce electricity.

The coal combustion process that the applicants are proposing for two of the 615 MW base load units at the ERGS is more advanced than the conventional process and employs supercritical pulverized coal (SCPC) technology. SCPC technology involves heating water to a temperature and pressure that exceeds its critical point. The critical point of water is above a pressure of about 3,200 pounds per square inch absolute (psia) and 705 degrees Fahrenheit (°F). Above the critical point, distinct liquid and vapor (gas) phases no longer exist and the state of the water is that of a supercritical fluid. Instead of boiling, water is continuously transformed from the liquid phase to a steam as the temperature of the supercritical fluid is increased. In a supercritical steam generator, no steam drum is required to separate steam from liquid.

The higher temperatures and pressures achieved in a supercritical steam generator increase the energy content of the fluid delivered to the turbines. Increasing the energy, or enthalpy, drop across the turbine improves efficiency. The use of cold Lake Michigan water in the condenser of the SCPC units at the ERGS would also increase plant efficiency. The lower condenser temperatures achieved as a result of using colder circulating water would result in lower condensing temperatures and pressures, and hence, energy in the condensed steam. Greater plant efficiency means less fuel burned per unit of electrical output.

Figure 6-3 provides a schematic of the overall SCPC plant process. The site layouts for the North Site, South Site, and South Site-Exp are shown in Figures Vol. 2-1, 2-2, and 2-3. The new site layout for the CUP Option (using the North Site) that was negotiated between WEPCO and the city of Oak creek in May 2003, is shown in Figure Vol. 2-4. The company states that based on preliminary engineering, the steam generator for the SCPC units would be a supercritical pulverized coal, balanced draft-type unit. The generating unit would be designed to operate as a base-loaded facility, but the design would allow for cycling to accommodate load required by the electrical system demand.

Figure 6-3 SCPC plant process



The steam generation process involves pumping feedwater through the economizer to recover heat from the combustion gases exiting the steam generator. The water is then pumped through to the water wall circuits enclosing the furnace. After passing through the lower and upper furnace circuits in sequence, the fluid passes through the convection enclosure circuits to the steam generator's superheater section. The fluid is mixed in cross-tie headers at various locations throughout the path.

The steam then exits the steam generator enroute to the high-pressure turbine. High-energy fluid from the steam generator enters the turbine at approximately 3,500 psig/1,050 °F. The supercritical fluid initially flows through the high-pressure turbine and then returns to the steam generator for reheating. It then returns to the intermediate-pressure section. After passing through the intermediate-pressure section, the steam enters a cross-over/cross-under pipe, which transports the steam to the low-pressure section. The steam then divides into multiple paths and flows through the low-pressure sections exhausting downward into the condenser.

In the air and combustion process, air from the forced draft fans is heated in the air preheaters, recovering heat energy from the exhaust gases on its way to the stack. This air is distributed to the burner windbox as secondary air. The primary air fans supply a portion of the combustion air. This air is also heated in the air preheaters and then used to transport the fuel to the pulverizers while drying the fuel in the process. A portion of the air from the primary fans is routed around the air heaters and is used as tempering air for the pulverizers. Preheated air and tempering air are mixed at each pulverizer to obtain the desired pulverizer outlet temperature.

The pulverized coal and combustion air mixture flows to the coal nozzles at the various furnace elevations. The hot combustion products rise to the top of the steam generator and pass horizontally through the superheater and reheater in succession. The gases then turn downward, passing in sequence through the primary superheater and economizer. The gases exit the steam generator at this point, and flow to the selective catalytic reduction system, preheater, fabric filter, induced draft fans, flue gas desulfurization system and stack.

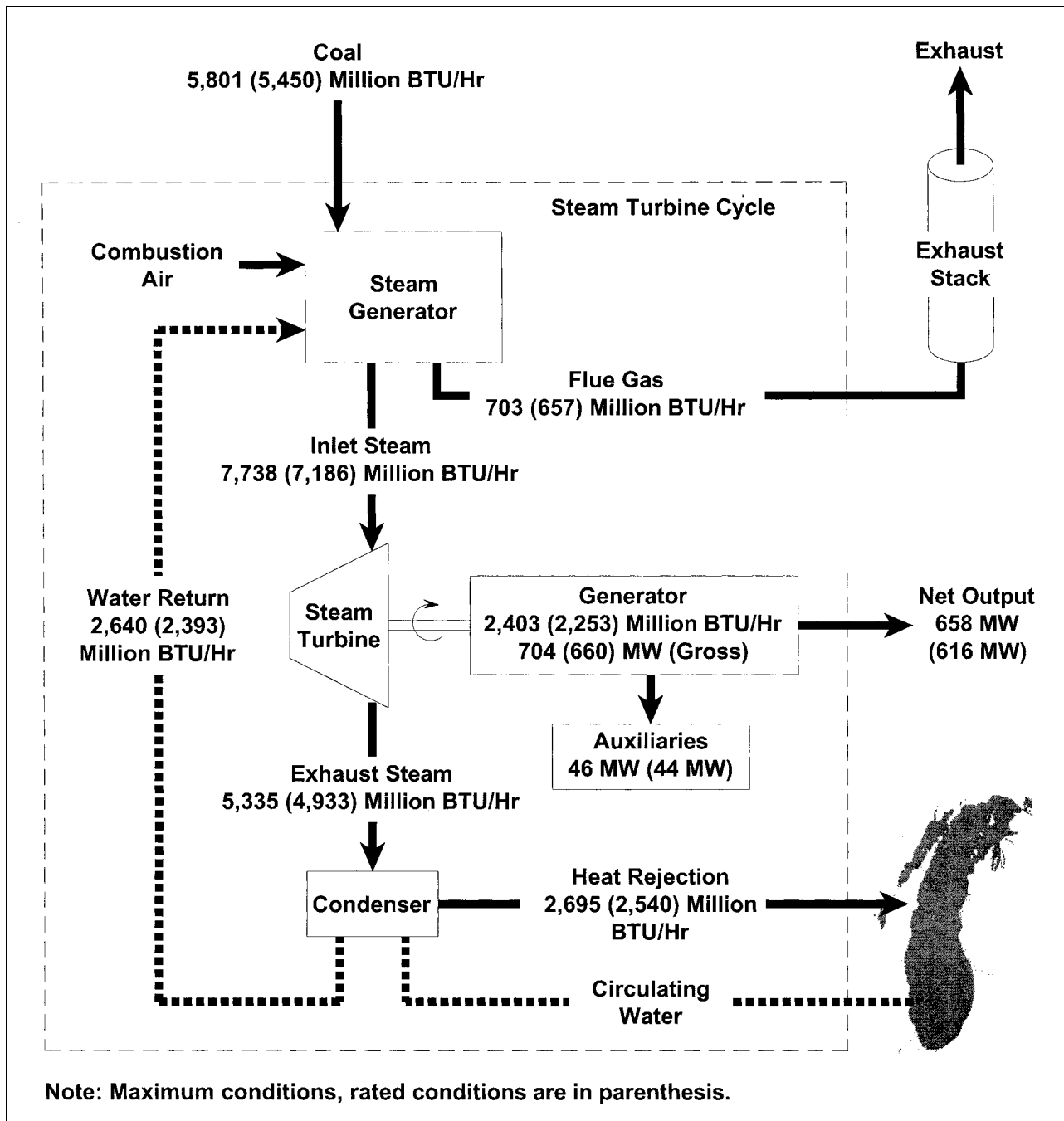
#### **Expected hours of operation, expected outages, and life expectancy**

The assumed capacity factor for the SCPC facility is in the range of 85 to 90 percent. The applicants expect the plant to be operated, for the majority of the year, as a base-load facility over a life of 40 to 45 years. The plant is expected to operate 24 hours per day. Each unit would be expected to operate between 7,426 and 7,862 hours per year.

Reductions in annual output for the units are expected to occur from two planned outages each year, forced outages due to unplanned equipment failures, and partial load reductions required due to miscellaneous process limitations. Generally, planned power plant outages would relate to periodic inspections based on a combination of hours run and start-ups.

The rated heat load input is estimated to be 5,450 million British thermal units (mmBtu/hr) as shown in Figure 6-4. This heat input would double for both units. In general, the SCPC units would convert approximately 38 to 39 percent of the heat content into electricity.

Figure 6-4 Heat balance diagram for one SCPC unit



### Fuel source and supply

Bituminous coal would be the primary fuel for the SCPC generating units. For planning and air permitting purposes, eastern United States Pittsburgh #8 bituminous coal is the applicants' bituminous coal of choice,

with the Blacksville Mine as a typical operation that can supply this coal. This coal seam is located and predominantly mined in Pennsylvania and West Virginia.

The SCPC units are being designed to burn a washed fuel.<sup>72</sup> Table 6-2 provides the ultimate analysis of the potential coal fuel source and ash content. For marketing coal combustion/conversion products, higher ash content coals are more desirable.

**Table 6-2 Typical values for coal and ash for Pittsburgh #8 bituminous coal**

<b>Coal Ultimate Analysis</b>	<b>Units</b>	<b>Pittsburgh #8 Washed Bituminous Coal</b>
Carbon	%	72.67
Sulfur	%	2.69
Oxygen	%	4.84
Hydrogen	%	4.89
Nitrogen	%	1.38
Chlorine	%	0.10
Ash	%	7.73
Moisture	%	5.71
<b>Coal Proximate Analysis</b>		
Moisture	%	5.71
Volatile Matter	%	35.73
Fixed Carbon	%	50.84
Ash	%	7.73
Gross (Higher) Heating Value	Btu/lb	13,100.00
Hardgrove Grindability Index		55.00
<b>Coal Ash Analysis</b>		
Silica	%	43.17
Ferric Oxide	%	21.17
Alumina	%	21.95
Titanium Dioxide	%	0.93
Calcium Oxide	%	5.18
Magnesia	%	0.90
Sulfur Trioxide	%	4.28
Potassium Oxide	%	1.45
Sodium Oxide	%	1.06
Phosphorous Pentoxide	%	0.59
Undetermined	%	0.68
Total	%	100.00

Each of the two SCPC generating units is expected to have a maximum coal consumption of 5,640 tons per day, or roughly 1.8 million tons per year. WEPCO stated that it has had discussions with coal suppliers and

<sup>72</sup> DR-032 indicates that coal washing will not occur on-site. It will occur prior to coal delivery.

transportation providers but no final decisions on the initial provider of coal, and associated contract terms and conditions for either the coal or transportation, have been made.

### **Fuel transportation and storage**

The preferred method for coal delivery to the power plant site is by rail. If coal is delivered directly to the site, it would be delivered by unit trains consisting of 130 to 150 rail cars averaging 100 to 120 tons per car.

Delivery from Lake Erie or Chicago coal docks via lake vessels that deliver coal to the ERGS site is also an option. If coal is delivered from Lake Erie or Chicago coal docks, lake vessels about 1,000 feet long, carrying between 15,000 tons to 45,000 tons of coal would be utilized. A proposed new breakwater east of the existing dock and a northward expansion of the existing dock would provide a protected area to facilitate lake delivery of coal. If lake delivery of coal is implemented, it is likely that some rail delivery would still occur due to weather related restrictions that affect Great Lakes shipping in the winter. Without supplemental rail delivery, the coal stockpile at the plant would need to meet a four-month supply, due to possible winter shipping stoppages. Given that there is not sufficient space to accommodate a four-month supply of coal on the existing dock and proposed storage areas, WEPCO has expressed a preference for rail deliveries that could accommodate fuel delivery needs at the facility year round.

The existing Oak Creek coal delivery rail system holds one train with room for another on a railroad siding just outside the plant property. To accommodate the larger number of trains expected if the ERGS is built, another rail spur, a rotary car dumper, and a car positioner (indexer) would be added to the plant's rail system. The new plan for accommodating the ERGS facilities would allow two full and two empty trains on the ERGS-OCPP site.<sup>73</sup> The existing dumper and associated conveyors would be removed.

Figure 6-5 shows a conceptual design of the coal handling process following delivery to the site. Rail car unloading would be done using a rotary car dumper. After completing modifications to the rail loop on the plant property, an entire unit train, consisting of up to 150 cars, could be pulled through the site without breaking the train into smaller segments. The installation of the new car dumper and the car positioner (the indexer) would increase the speed of the unit train unloading process. The applicants estimate that an entire unit train could be unloaded in about six hours.

Coal from the dumper would be discharged onto a belt conveyor that would move the coal to a transfer house. All new coal belt conveyor transfer points would include dust suppression or collection systems consisting of fog, water, or baghouse filter; a fire protection system; and exhaust fan ventilation. Coal belt conveyors handling crushed coal would be located inside steel galleries; whereas conveyors handling uncrushed coal would be covered. Galleries would be provided with service water for washdown clean-up, compressed air and welding outlets for conveyor maintenance, lighting, automatic fire protection, and ventilation. Transfer buildings would include the same ancillary features for clean-up as the coal conveyor galleries.

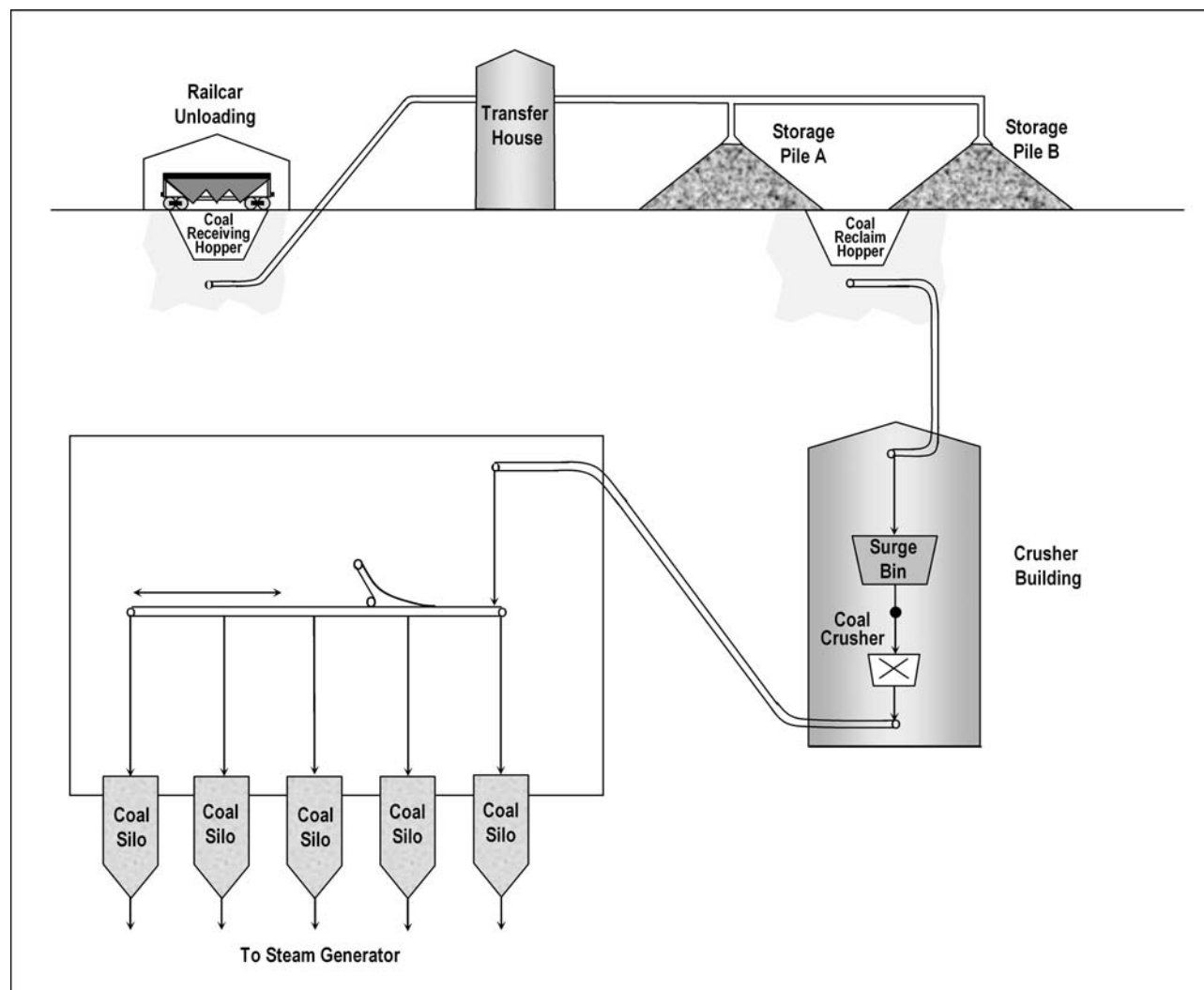
After the transfer house, coal would be conveyed to an inactive coal pile reclaim area or to the coal crushers. There are two types of coal storage: inactive outdoor storage and active indoor storage. The inactive coal storage area would hold coal that is being held in reserve, and would be located north of the existing coal

---

<sup>73</sup> Response to 1-SUP-145

dumper. Each pile would be stacked out and reclaimed using mobile equipment that interfaces with the stationary systems at the surge pile stackout conveyors and reclaim hoppers. The active coal storage piles would be enclosed in a coal storage shed, storing enough coal for three day's operation. The active storage stockpile would serve as the buffer between the steam generator's continuous demand and the intermittent arrivals of bulk shipments.

Figure 6-5 Coal handling process for the ERGS project



Total on-site storage capacity would be approximately 1.2 million tons of coal. The company notes that all new coal storage areas would be equipped with clay liners, concrete or some other type of suitable barrier to minimize infiltration, a curbed runoff collection system, and a lined pond to detain and treat coal pile runoff.

Coal would be supplied to individual silos located at the site of each generating unit. Coal would be discharged from the storage silos to variable speed gravimetric feeders where the coal feed rate would be regulated by the combustion control system and unit load demand. Coal would then be discharged from the

gravimetric feeder to the pulverizer. The coal would then be transported to the burners using primary air as the conveying media.

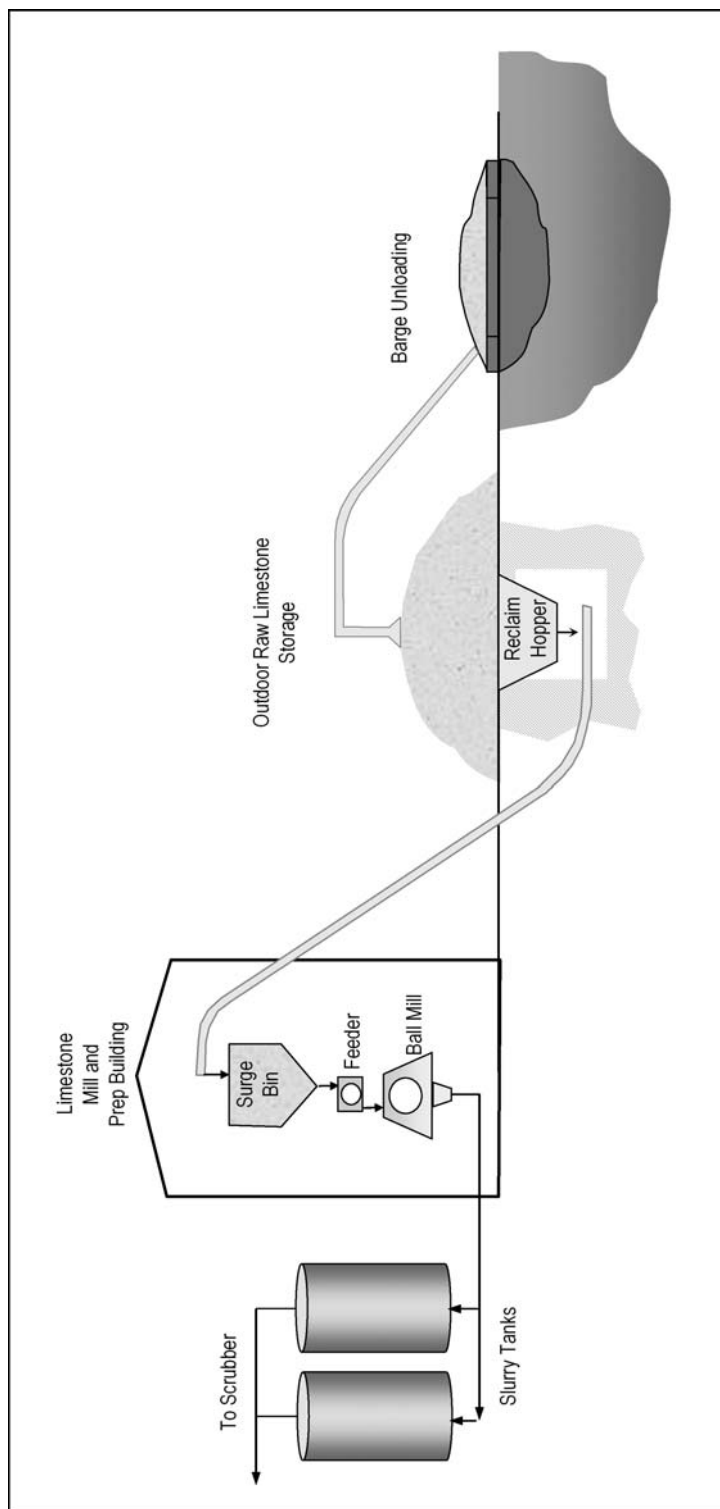
### **Limestone transport and storage**

Limestone would be delivered to the power plant site by rail delivery or barge delivery. If barge delivery is used, a grab bucket type unloading system would convey limestone from the barges to the receiving hopper. If rail delivery is used, limestone would be conveyed from the rail loop to the dock. The limestone receiving hopper would include a dust suppression system to minimize fugitive dust generated from the unloading operation. A belt conveyor and a telescopic chute would be used to convey limestone to an open storage pile. A typical limestone unloading and handling process is shown in Figure 6-6.

Limestone would be stored on an open pile in a segregated area on the existing coal dock. The limestone would then be pushed into a reclaimer hopper and transported by conveyor to the crushers as needed. The company anticipates having a four-month supply of limestone on the storage pile. This would provide a sufficient amount to cover the winter months, should the limestone quarry operations and shipping on the Great Lakes be shut down.

As shown in Figure 6-6, wet ball mills produce a pulverized limestone slurry for use in the Flue Gas Desulfurization (FGD) system. Limestone and water are added at the inlet to the ball mill. The limestone is then ground in the ball mill to produce a slurry that is discharged into the mill slurry tank. Mill recycle pumps convey the limestone water slurry to an assembly of hydroclones and distribution boxes. Based on suspended solids content and size distribution, the slurry is then separated in streams. The hydroclone underflow, which is comprised of oversize limestone particles, is directed back to the mill for further grinding. The hydroclone overflow is routed to reagent storage tanks. Reagent distribution pumps pump limestone slurry from the storage tanks in a recirculation loop to the absorber modules.

Figure 6-6 Limestone unloading and handling process for the ERGS project



### **Water use, storage and discharge**

Table 6-3 shows the estimated water demands for the SCPC plant operation. A water balance diagram is shown in Figure 6-7

**Table 6-3 SCPC water demands for one unit at various operating modes**

<b>Once-through Cooling Water</b>	<b>Rated Load Operation (gpm)</b>
Condenser	450,000
Service water	10,000 to 13,250
<b>City Water Supply</b>	
Potable water	5 to 10
Steam generator make-up	100 to 200

Potable water would be available from the existing city supply. Water from Lake Michigan would be used at the plant site to supply cooling water to condense the low-pressure turbine exhaust steam at the anticipated flow-through rate for each SCPC unit. This flow-through rate would be 458,000 gallons per minute (gpm), with a 12 degree temperature rise. Because the SCPC plant would operate in a once-through manner, the amount of water withdrawn from the intake structure would be essentially equivalent to the amount of water discharged. The largest water consumption would occur in the FGD system.

A new pump house would be installed in a location that would be southwest of the proposed SCPC units on the North Site. OCPP units 5-8 would utilize the existing south plant pump house that would withdraw water from the planned forebay area that would enclose the western end of the intake channel. Both the forebay and new SCPC pumphouse locations would be connected to the proposed intake tunnel by means of a vertical dropshaft.

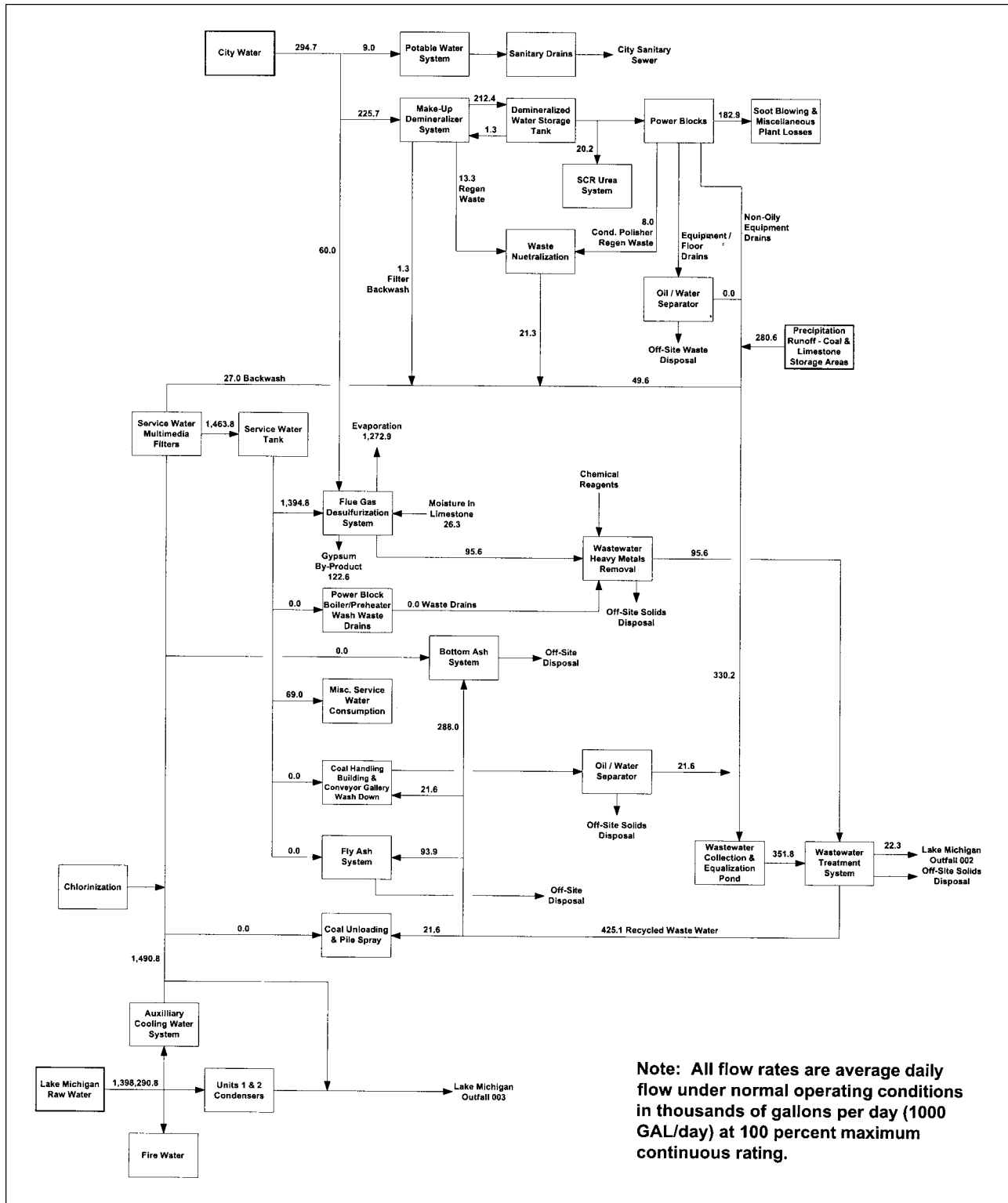
New circulating water pumps would also need to be installed. These new pumps would be designed to have the capacity equal to the highest optimum flow for the seasonal range of lake temperatures, heat rejection at full load, and desired discharge temperature. Cooling water would be piped to the main condensers of both the first and second SCPC units via an underground large diameter piping system. If the North Site is used, discharge water from the condensers for both proposed units would be piped underground to the north side of the new dock extension and then east along the shoreline (see Figure Vol. 2-1). If the facilities are built on the South Site or the South Site-Exp, discharge water would be piped underground to a discharge channel located directly off of the southeast corner of the proposed SCPC units (south of the coal dock). See Figures Vol. 2-2 or 2-3.

### **Solid waste production, storage, and beneficial use**

The primary coal combustion/conversion products produced at a SCPC power plant are fly ash, bottom ash, and synthetic gypsum.

WEPCO has stated that its long-term goal is to utilize 100 percent of the coal combustion products (CCP). The company estimates that the combined total of coal combustion/conversion materials produced by the SCPC units would be:

Figure 6-7 Water balance diagram for the SCPC units (using Pittsburgh #8 bituminous coal)



Fly Ash	206,300 tons/year
Bottom Ash	51,600 tons/year
Synthetic Gypsum	543,600 tons/year

Due to the company's need to characterize and demonstrate consistency in CCP materials, develop markets and new customers, and establish uses for these materials, WEPCO anticipates reaching full utilization of these products within ten years from the start of commercial operation of the two SCPC units.

Fly ash and bottom ash CCP have several beneficial uses. Fly ash, which accounts for 80 percent of the coal ash produced, is widely used in the production of concrete and concrete products, portland cement, controlled low strength materials, liquid waste stabilization, cold in-place recycling of asphalt, and soil stabilization. Bottom ash, which accounts for the remaining 20 percent of the coal ash, is used primarily as an alternative for sand, gravel, and crushed stone pavement, and parking lot and foundation base materials. Synthetic gypsum uses are described below.

#### **Fly ash**

Fly ash is collected in the fabric filter or electrostatic precipitator ash hoppers and the air heater hoppers. The fly ash would be transported from the ash hoppers to a fly ash silo via a pneumatic transport line using low-pressure air from a blower. From the silo, the ash would be unloaded, either wet or dry, into a truck which would transport the ash to its final usage location, i.e. landfill or commercial use.

#### **Bottom ash**

Bottom ash from the steam generator is collected and transported from the bottom of the boiler via a submerged scraper (drag chain) conveyor to either a concrete holding pad or a holding bin (hydrobin). The ash would then be loaded from the pad to a truck with a front end loader or directly from the bin to a truck. The truck would then take the ash to its final usage location, i.e. a landfill or an commercial use.

#### **Synthetic gypsum**

Gypsum (calcium sulfate) is produced in the wet Flue Gas Desulfurization (FGD) system by the injection of oxygen to mix with calcium sulfite produced in the absorber reaction tank. Currently, there are no FGD systems operating in Wisconsin boilers. The gypsum dewatering system removes water from the slurry leaving the FGD absorber modules. The recirculating reagent in the FGD absorber vessel accumulates dissolved and suspended solids, as byproducts from the SO<sub>2</sub> absorption reaction process. To maintain quality of the reagent, a portion of the reagent needs to be withdrawn and replaced by fresh reagent on a continual basis. This is done by the bleed pumps pulling off spent reagent, and the reagent distribution pumps supplying fresh reagent to the absorber.

Dewatering of the gypsum slurry is accomplished in two stages. The primary dewatering stage utilizes hydroclones which use centrifugal force to concentrate the slurry. Underflow from the hydroclones, which would typically have 35 to 50 percent solids levels, is sent to vacuum filters for secondary dewatering. The vacuum filters would reduce the gypsum filter cake moisture content to 10 percent or less. Either rotary drum or horizontal belt filters could be utilized depending upon the end user's requirements for the gypsum. Overflow from the hydroclones, which would have 3 to 5 percent solids, is returned to the absorbers. A belt conveyor system would transport the gypsum from the vacuum filters located in the dewatering building to an adjacent storage shed. Plans are for the gypsum to be eventually transported to a wall board manufacturing plant if one is built nearby or barged off-site.

Natural gypsum is mined at various locations in the country for production of wallboard (drywall or sheet rock) and other products. Quality synthetic gypsum material produced from the proposed wet scrubbers could also be used for the production of wallboard and other products. The quantity of gypsum produced is directly proportional to the sulfur content of the fuel being burned.

The company would, ideally, like to be in a position to produce a sufficient amount of gypsum for use at a dedicated commercial wallboard plant located either on or near the power plant property. WEPCO is currently investigating the feasibility of having a wallboard manufacturer locate a new facility in close proximity to the plant site. It is possible at a later date that a new wallboard facility could be located at the Oak Creek South Landfill Site or at an area industrial park. This type of plant, combined with outdoor gypsum storage, could require a site of up to 100 acres. If smaller quantities of gypsum are produced, WEPCO notes that the gypsum materials could be transported to an existing wallboard producer to supplement natural gypsum supplies.

## **Integrated gasification combined-cycle (IGCC)**

### **Description of the technology and plant components**

The applicants propose to develop a new 600 MW net nominal baseload Integrated Gasification Combined Cycle (IGCC) electric generating facility for commercial operation starting in 2011. The proposed IGCC process is designed to break down coal into its basic constituents and obtain a synthetic gas (syngas) that would be burned in two combustion turbines. The gas conditioning process enables the separation of any pollutants from the syngas prior to its use as fuel in the CT's. Waste heat is also utilized to produce steam for steam turbine use. The proposed IGCC system consists of:

- Two or three oxygen-blown, coal gasifiers
- An air separation unit (ASU)
- A gas conditioning system for removing sulfur compounds and particulates
- Two CT's with heat recovery steam generators (HRSGs)
- A steam turbine generator (STG)
- Systems for coal handling and preparation equipment

Demolition of the former north plant building would be necessary before the IGCC facility could be constructed at the North Site.

The equipment described by WEPCO in its CPCN application is based on the existing Texaco Gasification Power System process and available combined-cycle power plant technology. It represents one of several IGCC technologies that are currently being developed.

Because technology changes (in both gasification and combustion turbine science) are likely to occur between now and when the IGCC facility is proposed to be in service in 2011, the information described in the application is preliminary. As technologies develop, a more thorough screening process would be implemented to select the appropriate technology and vendor for use on this project.

A two-train gasifier system (with potential addition of a spare) is proposed. A schematic for the IGCC process is shown in Figure 6-8.

The overall “footprint” of the entire facility would cover about 25 to 30 acres. The approximate size of each major components is:

- Air separation unit – 500 x 650 feet
- Combined cycle power plant – 300 x 400 feet
- Gasification facility – 550 x 550 feet
- Acid gas recovery unit – 275 x 300 feet
- Sulfur recovery unit – 275 x 275 feet
- Water treatment building – 60 x 120 feet
- Waste water treatment building – 60 x 120 feet
- Coal slurry/preparation facility – 120 x 160 feet

The site layouts are as shown in Figures Vol. 2-1, 2-2, and 2-3.

### **Gasification plant**

The Texaco coal gasification technology uses a single-stage, downward-firing, entrained-flow coal reactor fed with a coal/water slurry (60 to 70 percent solids) and 95 percent pure oxygen. The coal reacts with steam and oxygen at a temperature in excess of 2,600<sup>0</sup>F to produce raw synthesis gas and molten slag.

The main sub-systems of the gasification plant include: gasifier, ASU, low temperature gas cooling (LTGC), acid gas removal (AGR), and SRU. The following sections describe each sub-system.

#### **Gasifier**

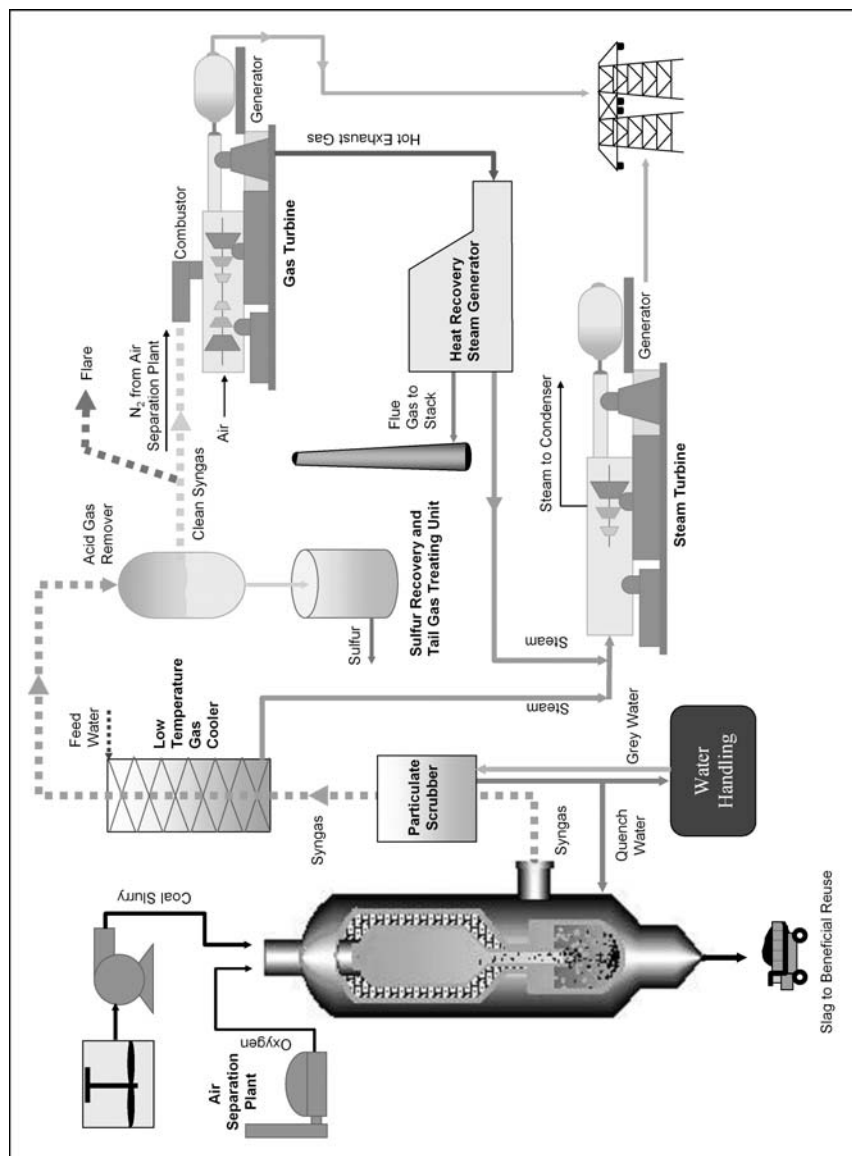
In the gasifier, the slurry is mixed with oxygen in a specially designed feed injector. The oxygen-limited atmosphere inside the gasifier vessel generates syngas. Syngas consists primarily of hydrogen and carbon monoxide (CO) with lesser amounts of carbon dioxide (CO<sub>2</sub>), H<sub>2</sub>S, methane, argon, nitrogen, and water vapor. Traces of carbonyl sulfide and ammonia also are formed. Inorganic mineral matter, which was present in the coal and the unconverted carbon in the gasifier, form a liquid melt called slag.

Hot syngas and slag flow downward into the gasifier quench chamber via a dip tube. The syngas and slag are intimately mixed with and cooled by quench water at the bottom of the dip tube. The raw syngas leaves the gasifier quench chamber and enters a syngas-scrubbing step to remove entrained particulates. The carbon-rich particulate material is recycled back to the gasifier.

#### **Acid gas removal (AGR) plant and flare**

The cool syngas then passes through the AGR plant where over 98 percent of the sulfur containing compounds are removed. This is accomplished by absorbing the H<sub>2</sub>S in a circulating solvent stream. This “rich” solvent then flows to a second column where heat is used to remove the H<sub>2</sub>S from the solvent. The H<sub>2</sub>S free or “lean” solvent is then returned to the absorber where more H<sub>2</sub>S is removed.

Figure 6-8 IGCC plant process



### Air separation plant

The ASU supplies high-pressure, high purity oxygen for gasification and nitrogen to dilute the fuel fed to the CTs. The ASU operates at cryogenic temperatures and will produce 95 percent pure oxygen. It also will be designed for full nitrogen recovery. Nitrogen also is used for inert gas purging. Oxygen also will be supplied to the sulfur recovery plant to increase efficiency.

### Low temperature gas cooling

The particulate-free clean syngas from the particulate scrubber is routed to the LTGC section. The syngas is cooled and heat is recovered by generating steam. Most of the water in the syngas is condensed and extracted prior to reaching the AGR section.

The sulfur compounds released in the stripper are then processed in the SRU using a multi-step catalytic process to produce an elemental sulfur by-product.  $\text{SO}_2$  that is not converted to elemental sulfur is routed to the Tail Gas Treating Unit (TGU) for conversion to  $\text{H}_2\text{S}$  and recycled to the SRU. After leaving the AGR section, the clean syngas is sent to the CTs.

In the event that syngas quality is not adequate for use in the CTs, it would be ignited in a stack approximately 200 feet tall. The maximum height of the flare has been estimated at 80 feet.<sup>74</sup> During a normal startup the height of the flare is expected to be 56 feet. It is expected that the length of time that syngas would be flared is four hours during normal startups.

#### **Sulfur recovery unit (SRU)**

In the sulfur recovery plant, the sulfur-containing gases from the AGR system are converted to elemental sulfur or sulfuric acid. Either by-product would be suitable for sale to other industries for various process uses. The conversion of  $\text{H}_2\text{S}$  to sulfur involves a multi-step catalytic process in which the reaction of  $\text{H}_2\text{S}$  and  $\text{SO}_2$  form water and sulfur.

The sulfur is removed in the TGU prior to venting the  $\text{CO}_2$  to the atmosphere. In the TGU, hydrogen is reacted with the  $\text{SO}_2$  to convert it back to  $\text{H}_2\text{S}$ . The  $\text{H}_2\text{S}$  is then absorbed in a very selective solvent and the other gases are vented. The absorbed hydrogen sulfide is removed from the solvent in a stripping column and recycled to the SRU.

If elemental sulfur is produced, a storage tank would be provided to hold molten sulfur until it could be transferred to railcars for shipment off-site. If sulfuric acid were produced, an aboveground storage tank would be constructed to temporarily hold the acid until it could be transported off site by specially designed rail cars or trucks for commercial use.

#### **Combustion turbine**

The facility would employ industrial frame, advanced technology CTs. Each CT would be housed in an enclosure that provides thermal insulation, acoustical attenuation, and fire extinguishing media containment. The enclosure would allow access for routine inspections and maintenance. Each CT would be furnished with all accessories and auxiliary systems required for start-up and generating capability for combined-cycle operation. Each CT would incorporate an air inlet system with specially designed equipment and ducting to modify the quality of air under various temperatures, humidity, and contamination situations in order to make it more suitable for use. The self-cleaning inlet air filter would utilize high efficiency media filters. The inlet air ducts also would have noise attenuation features.

Either a recirculating hydrogen gas stream cooled by gas-to-water heat exchangers or water-to-air heat exchangers would cool the turbine generators. A hydrogen storage system would be provided to maintain the hydrogen pressure in the generators, if cooled by hydrogen. The hydrogen system would consist of standard pressurized hydrogen storage cylinders connected to a generator manifold supplied with the generator. A  $\text{CO}_2$  system would be provided to purge the hydrogen from the generators. The  $\text{CO}_2$  system would consist of standard pressurized  $\text{CO}_2$  cylinders connected to a manifold supplied with the generator.

---

<sup>74</sup> Response to 1-DR-019

### **Heat recovery steam generator**

One important feature of a combined-cycle plant is the use of hot exhaust gas from the CT to produce steam which in turn, is expanded in a steam turbine to drive an electric generator and produce electricity. The HRSG is the key piece of equipment necessary for steam production. The HRSG units are designed to fully integrate with the combined-cycle plant and include required inlet/outlet ductwork, structural supports, piping and accessories. The HRSGs would be multiple-pressure reheat type steam generators. The various pressure sections would consist of economizer, evaporator and superheater sections. The HRSGs also would be equipped with a reheater to further improve cycle efficiency. Supplemental duct-firing also may be installed. One tank would be provided for each HRSG to receive blowdown and water/steam releases. This blowdown, in conjunction with the chemical feed system, would control the steam drum water chemistry. A nitrogen blanketing system (consisting of N<sub>2</sub> cylinders) would be used during long-term shutdowns to protect the internal surfaces of the HRSGs.

### **Steam turbine generator**

The STG would be a multiple admission, reheat, condensing turbine with an electric generator. The HP portion of the STG receives high-pressure superheated steam from the HRSG and then exhausts steam into the reheat section of the HRSG. Reheated steam from the HRSG is supplied to the intermediate pressure (IP) turbine, and the IP turbine exhausts into the LP turbine. The LP turbine also receives low-pressure superheated steam from the HRSG and exhausts steam into the condenser. Steam also would be produced in the gasification process and then supplied to the STG. An auxiliary steam system also would be provided.

### **Emissions control equipment**

Additional information regarding emission control technologies and equipment can be found in Chapter 7.

#### **NO<sub>x</sub> control**

Nitrogen, supplied by the ASU, is added to the combustors in each CT to reduce NO<sub>x</sub> emissions. The added nitrogen gas reduces the combustion temperature to minimize NO<sub>x</sub> emissions to about 15 ppm (0.06 lb/mmBtu). Additional post-combustion devices are not proposed.

#### **Particulate control**

Particulate removal to a level of about 0.011 lb/mmBtu occurs by a combination of good combustion practices and the syngas production process. Post-combustion equipment would not be required.

#### **SO<sub>2</sub> control**

IGCC facilities do not require any post-combustion SO<sub>2</sub> controls. Sulfur removal occurs in the AGR plant as part of the syngas production process. Approximately 98 percent of the sulfur is removed in the syngas conversion process.

#### **Hazardous air pollutants (HAPs) control**

HAPs, including mercury, would be controlled in the gasification process. Information from currently operating IGCC facilities suggests that at least 50 percent of the mercury is removed in this gasification process.

### **Expected hours of operation, expected outages, and life expectancy**

The assumed capacity factor for the IGCC facility is in the range of 75 to 80 percent. The applicants expect the plant to be operated, for the majority of the year, as a base-load facility over a life of 40 years. The plant is expected to operate 24 hours per day at full capacity when available.

Reductions in annual output for the units are expected to occur from two planned outages each year, forced outages due to unplanned equipment failures, and partial load reductions required due to miscellaneous process limitations. Generally, planned power plant outages would relate to periodic inspections based on a combination of hours run and start-ups.

The rated heat load input is estimated to be 5,035 million British thermal units (mmBtu/hr) as shown in Figure 6-9. The IGCC unit efficiency would be 37 percent, which currently is slightly less than a SCPC unit under the same conditions.

Since the IGCC technology is relatively new, there are several issues with the proposed IGCC unit at Elm Road that should be considered from a reliability standpoint.

- Equipment malfunctions continue to hinder its effectiveness.
- More adaptations for a colder climate are needed for the IGCC compared to other units. A large amount of electrical heat tracing for the gasifier would be required to accommodate colder climates.
- The technology and process have been proven to work, but reliability is compromised due to many mechanical failures.
- A long startup (up to four days) for the Air Separation Unit is required.
- There are concerns about scaling up the plant. The Elm Road IGCC facility would be twice the size of other existing units and would be the largest in the USA.

### **Fuel sources and supply**

Bituminous coal would be the primary fuel for the IGCC generating unit. For planning and air permitting purposes, eastern U. S. Pittsburgh #8 bituminous coal, is the company's bituminous alternative of choice, with the Blacksville Mine as a typical operation that can supply this coal. This coal seam is located and predominantly mined in Pennsylvania and West Virginia.

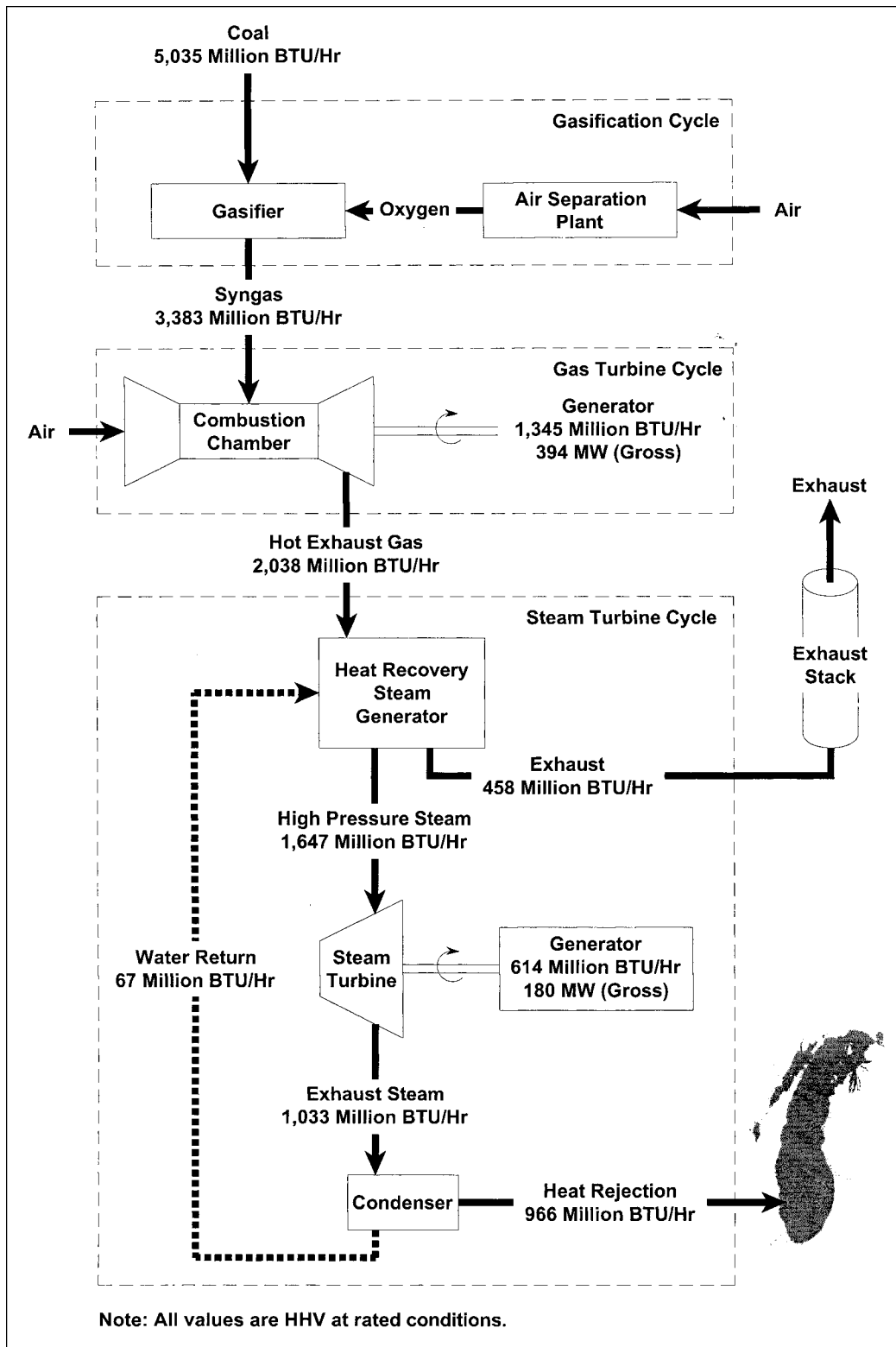
Table 6-2 in the SCPC section outlines the potential coal fuel sources and ash content. Note: IGCC facilities elsewhere have utilized other fuel sources such as petroleum coke.

The IGCC generating unit would be expected to have a maximum coal consumption of 5,540 tons per day, or roughly 1.6 million tons per year.

### **Water use and storage**

The proposed IGCC unit would require water for coal gasification, cooling the compressors used in the ASU and for steam condensing. At this time, the plan for the cooling water supply would be a pumping station and pipeline drawing water from the common intake structure.

Figure 6-9 IGCC heat balance for one unit



Construction of a new cooling water intake structure would be expected to occur during construction of the first SCPC unit. This new intake would support the IGCC facility and would be a shared facility with the SCPC units and existing units 5-8. Cooling water use for the IGCC facility would be expected to be similar to that of a conventional steam electric power plant as shown in Figure 6-10. Compared to a conventional plant that uses nearly all its cooling water for steam condensing, the IGCC would require about one-third that amount for steam condensing. However, the air separation unit used to produce pure oxygen fed to the gasifier would require a considerable cooling water supply and, when combined with steam condensing requirements, the amount of water used for once-through cooling at an IGCC facility is comparable to a conventional steam electric plant.

Additional information about cooling water intake structure plans is discussed in Chapter 7.

A service water system would supply various systems including cooling of auxiliary plant equipment (primarily various tube and shell heat exchangers), fire protection systems, and provide water to the gasification process.

### **Water treatment and discharge**

Wastewater from the slag handling process would need to be handled in a new wastewater treatment facility. Process wastewaters would be routed to either a wastewater facility that also handles the existing coal units or a new facility designed to process only the IGCC related wastewater.

### **Solid waste generation and use**

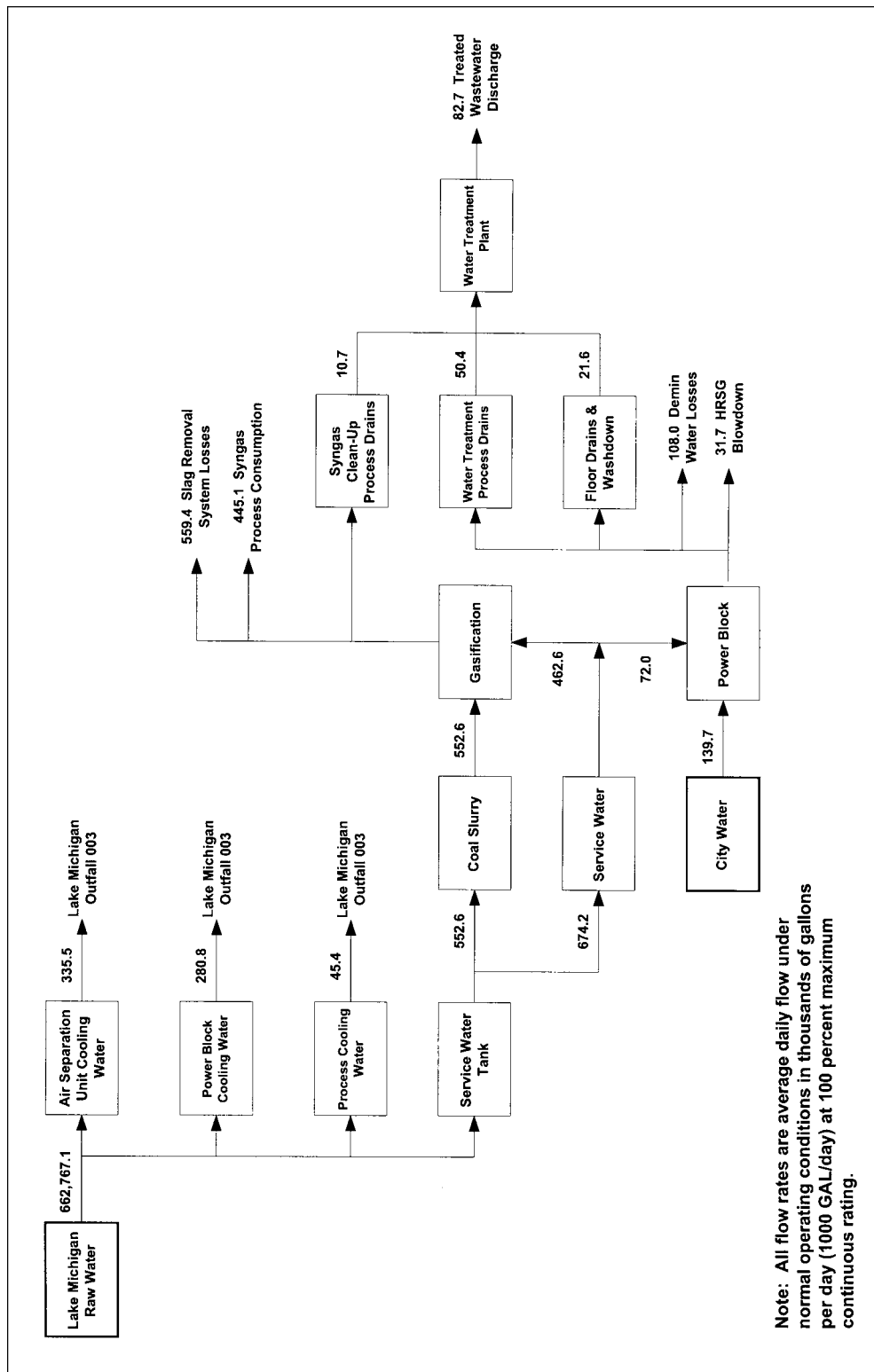
IGCC units would produce both sulfur and slag. It is expected that there would be a beneficial use market for these by-products, therefore little landfill use is expected.

### **Sulfur**

One of the primary raw syngas clean-up steps involves the removal of acid gas and the production of either elemental sulfur or sulfuric acid. Removal of 98 percent of the sulfur (present as hydrogen sulfide ( $H_2S$ )) can be achieved using existing technology. Both form of sulfur can be beneficially used and the form of sulfur produced would depend on market conditions.

Elemental sulfur and sulfuric acid production are directly related to the sulfur content of the coal. For the bituminous coal, the quantity of elemental sulfur generated annually is estimated to be about 33,200 tons/year and the quantity of sulfuric acid is approximately 109,200 tons/year. Based on preliminary discussions with potential vendors that may be able to sell either material, the market for sulfuric acid is currently much better than it is for elemental sulfur. In fact, WEPCO purchased over 425,000 gallons of sulfuric acid for use at its own generating facilities in 2000. Sulfuric acid produced from the AGR process could be used by existing and proposed WEPCO facilities. Elemental sulfur likely would require rail transportation to Florida for subsidized use in the fertilizer industry. If a 12,000 Btu/pound bituminous coal with a 3.2 percent sulfur content were utilized, sulfuric acid would be produced at 2,600 gallons/hour.

Figure 6-10 Water balance for the IGCC plant



Trucks holding 3,000 gallons of sulfuric acid would result in peak shipments to commercial users of 30 truckloads per day on a Monday through Friday basis. Rail cars hold a capacity of 10,000 to 11,000 gallons depending on the car and could be considered for longer distance shipments. Estimated quantities of elemental sulfur and sulfuric acid are very conservative as these values are based on a 3.2 percent coal sulfur content. Material quantities would change in proportion with the sulfur content of the coal or other fuel used. In other words, a one percent sulfur content in the fuel would produce one-third as much elemental sulfur or sulfuric acid compared to a three percent sulfur coal.

### **Slag**

The syngas process results in the formation of slag at the bottom of the gasifier. Liquid slag from the combustion section is solidified and fractured by contact with water. Slag produced would require some processing, but it could be expected to be of similar quality to bottom ash or a glass aggregate type product that can be beneficially used.

The coarse fraction of the slag would be removed from the quench section through a water-filled lock hopper system. The slag would be collected and stored in a retention pile that would be a commercial by-product. Slag produced in the IGCC process is a vitrified glass-like product. This material has a wide variety of beneficial uses including in the production of roof shingles, as a blasting grit, as a chip seal material for roads and parking lots or use as an alternative sand, gravel or crushed stone for pavements, parking lots or foundation bases. About 100,000 tons per year of slag would be expected from the proposed IGCC facility.

### **Landfill use**

Based on past experience, WEPCO expects to grow utilization of these new by-products from zero percent to full utilization within 10 years on a straight-line basis from the start of commercial operation of these new power plant units.

If necessary, landfill space would be available at the Caledonia site and other WEPCO-owned landfills. Only minimal amounts of the slag would be expected to be landfilled, as markets are developed for this new mineral resource.

Realizing that there could be an initial need for landfill space and that WEPCO would need to demonstrate 10 to 15 years of existing landfill capacity, the existing landfill capacity was reviewed and found to be sufficient for these additional materials assuming a straight line utilization growth rate from 0 to 100 percent over 10 years (see Chapter 8). Therefore, additional landfill space is not expected to be needed for the new coal-based units proposed.

## **Hazardous Chemicals Management**

A number of chemicals would be used and stored on-site during construction and operation of the ERGS facilities. The quantity, type and size of storage vessel, and containment plans for each of these chemicals are described below.

## Diesel fuel

### During construction

Diesel fuel and gasoline for operating a number of construction vehicles including dump trucks and excavation equipment would be temporarily stored on-site during construction, in tanks within above-ground containment units consisting of dikes capable of containing at least 110 percent of the storage tanks' capacity. The applicants have not specified the exact amount of diesel fuel that would be present on the site during soil excavation and stockpiling activities and construction of the SCPC and IGCC units. It has stated that potential bidders have suggested differing approaches to keep the high number of construction vehicles fueled. Options under consideration include a mobile fuel truck that would come to the site daily to fuel and lube the vehicles, a tanker trailer holding between (4,000 and 8,000 gallons) inside a secondary containment on a sled that is pulled around the site to staging locations, or the use of a fixed tank inside a secondary containment to act as a back-up to the mobile fuel truck. All trucks would carry spill kits.

A diesel storage location has not been identified but it would likely be located above the rim of the excavation pit away from Lake Michigan. Possible staging locations for refueling include at the point of excavation and backfilling as well as along the haul roads. Staging locations would move as the excavation and backfilling develop.

The construction superintendent would be responsible for reporting spills and overseeing the cleanup and disposal of any affected soil and spill clean-up materials. Minor spills of fuel or other chemicals would be cleaned with absorbent pads or other manufactured absorbent products. Larger-quantity spills would not be expected to exceed the capacity of a 55-gallon drum, and would be removed from within the containment area using a vacuum tank truck or by being pumped into a suitable container. Soil or absorbent materials that have come in contact with fuel or chemicals would be immediately removed, stored, and disposed of in accordance with state regulations. All construction equipment would be expected to be kept in good working condition so that transmission, hydraulic, or brake fluid leaks do not occur. The chemical storage areas would include hose stations, spill kits, safety showers, eye wash stations, and first aid kits.

## Other chemicals

Other chemicals expected to be on-site during construction and operation include various cleaning agents. They are listed in Tables 6-4 through 6-6.

Table 6-4 Typical chemicals stored during SCPC unit construction

Product	Nominal Quantity	Storage Method
Chemicals used in cleaning of piping		
Trisodium and disodium phosphate	2,500 lbs.	Delivered by contractor at time of service and stored in temporary tanks on-site
EDTA	40 gals.	
OSI-1 Inhibitor	10 gals.	
Sodium Nitrite	4,000 lbs.	
Pen-7 Surfactant	10 gals.	
Anti-foam agent	10 gals.	
Turbine cleaning		
Various Detergents		

**Table 6-5 Typical chemicals stored during IGCC construction and operation**

Product	Nominal quantity	Storage method
Methanol	10,000 gals.	Storage tanks
Monoethanol amine	3,000 gals.	Storage tanks
Oxygen	3 bottles	Steel pressure cylinders
Helium	3 bottles	Steel pressure cylinders
Hydrogen	20 bottles	Steel pressure cylinders
Lube oils	30,000 bottles	Lube oil tanks
Ammonium hydroxide (20%)	5,000 bottles	Storage tanks
Caustic soda	5,000 gals.	Storage tanks

**Table 6-6 Typical chemicals stored during construction and operation of the IGCC combustion turbine and heat-recovery steam generator**

Product	Nominal quantity	Storage method
Diesel fuel (start-up and emergency)	500,000 gals.	Storage tanks
Sulfuric acid (by-product)	200,000 gals.	
Sulfuric Acid (demineralizer)	5,000 gals.	
Sodium hydroxide (demineralizer)	5,000 gals.	
Oxygen	20 bottles	Steel pressure cylinders
Hydrogen (generator cooling)	20 bottles	
CO2 (hydrogen purging)	20 bottles	
Propane	10 bottles	
Acetylene	10 bottles	
Di-and trisodium phosphate (HRSG feedwater pH and scale control)	10 to 50 lbs. of each	Stored on pallets in granular form
Hydrazine or carbohydrazide (feedwater oxygen scavenger)	100 gallons	Drum storage
Step-up transformer insulation oil	15,000 to 20,000 gals.	Transformer vessel
Auxiliary transformer insulation oil	2,500 to 5,000 gals.	
Lube oils	15,000 gals.	Lube oil tanks (steel)
Hydraulic oil (steam turbine)	500 gals.	Oil tanks (steel)

Sodium hydroxide and sulfuric acid ( $H_2SO_4$ ) would also be stored on-site. These two chemicals are used in the water treatment process to produce demineralized water.

## Electric Transmission

### Interconnection on the plant site

The new generation for the ERGS project would have generator step-up unit transformers adjacent to the buildings housing the generators. The generators would produce power at approximately 20 kV. This power is raised to 345 kV to connect to the transmission network.

As originally proposed in the project application, the interconnection would consist of three circuits. Each circuit would be approximately 4,000 feet in length. For the North Site, the line route from the generators to the substation would travel southwest over the coal handling area, then south to the new expanded 345 kV substation. For the South Site (see Figure Vol. 2-1), the transmission interconnection lines from the SCPC units would head west northwest across the proposed rail loop track toward the expanded substation which would be located inside of the loop. The interconnection from the IGCC unit would proceed west along the south side of the rail tracks and then turn north, crossing several sets of railroad tracks to reach the substation (See Figure Vol. 2-2). The on-site transmission interconnection would be similar for the South Site-Exp, except that the connection from the IGCC unit would run in a more north-south direction, crossing the railroad tracks several times (see Figure Vol. 2-3).

In its Conditional Use Permit agreement with the city of Oak Creek, WEPCO has proposed to split the existing 345/138 kV substation into two portions and relocated them outside of the new proposed rail loop. A diagram showing this arrangement is shown as Figure Vol. 2-4 and described in Chapter 12.

## **Substation changes on the plant site**

For all site options proposed in the original CPCN application, the existing 345 kV substation would be expanded to the west with dimensions of approximately 500 feet by 500 feet. This equates to approximately a 40 percent increase in overall size. The modified substation and switchyard are shown in Figure Vol. 2-1. For the CUP Option, which was negotiated by WEPCO and the city of Oak Creek after the draft EIS was issued, a different location and layout for the substation changes has been proposed. The electrical duties and performance of the substation equipment would not change. The proposed substation location and layout related to the CUP Option and its potential environmental impacts are described in Chapter 12.

## **Possible system-wide transmission impacts**

The high voltage and extra high voltage transmission system additions for the ERGS are summarized in the Generation Interconnection Study Report, Final Summary Report for IC012 Revision 1, July 17, 2002.

Transmission lines and substations support a power plant's ability to deliver power to customer's load requirements. There are three basic requirements the transmission system provides:

Thermal Requirements – this defines the system capacity to not overheat and damage equipment or violate safety code clearances

System Stability – this defines the ability of the generator and other regional generators to stay synchronized with each other and not trip off line due to faults, power surges, etc.

Short-Circuit – this determines the ability of the equipment to remove faults from the system quickly and not damage equipment while maintaining the system integrity

For the purposes of the Generation Interconnection study, the ERGS project was proposed to be installed in three increments of 650 MW each. (In actuality, the two SCPC units would be 615 MW each and the IGCC capacity would be 600 MW.) The following tables and figures detail the items, purpose, and general location.

Tables 6-7, 6-8 and 6-9 below describe the transmission system improvements and costs that are associated with each of the generating units proposed for the ERGS project. Maps showing the transmission construction required for each generation increment are found in Volume 2. They are Figures Vol. 2-5, 2-6, and 2-7.

## **Stability issues**

One of the key issues for southern Wisconsin and northern Illinois power plants is to remain stable during different system load periods and with different generation levels at the many sites in the region. The ATC “Generation Interconnection Study Report, Stability Study for IC012 Phase 2 - July 15, 2002” details some of the alternatives to meeting the stability requirements when the second phase of the project (the second SCPC unit) comes on line. Three plans were studied.

At the initial time of the report’s issuance in 2002, the Pleasant Prairie to Zion to Libertyville 345 kV lines were deemed the best plan to meet all the needs. This solution had about 13 miles of line from Pleasant Prairie to Zion and about 17 miles of line to be rerouted west of Zion to tap the Libertyville 345 kV line. One of the alternatives was Plan D, which had a new Big Bend 345 kV substation on the Arcadian to Oak Creek 345 kV line, and a new Big Bend to Paddock 345 kV line which would be about 56 miles in length. The changes would include rebuilding some of the 138 kV lines connecting the Mukwonago, Whitewater, Janesville, Lakehead, Sunrise, Rock River and Paddock substations.

ATC issued a 10-Year Assessment Update February 2003. The update indicates the conceptual plan for a number of 345 kV lines in southern Wisconsin connecting to Illinois and Iowa. The Big Bend to Paddock 345 kV line is illustrated as one of several 345 kV lines that could meet future needs. The line is not being proposed at this time.

A third set of IC012 (Elm Road) interconnection studies are being conducted during the summer of 2003. The following generating units which were ahead of the first two ERGS units in the MISO generation list queue have been removed:

- #GIC001 (Midwest Power – Germantown) - 1194 MW, on the Arcadian – Zion 345 kV line
- #GIC003 (Badger Gen – Kenosha) – 375 MW on the Arcadian – Pleasant Prairie 345 kV line
- Reduction with 3 of 4 proposed units in northern Illinois resulting in the generation dropping from 2146 MW to 825 MW

Removal of these facilities will affect the incremental amount of transmission in the region required to interconnect the new generation and will change the thermal capabilities of the transmission system to move the power to the designated load area.

The new study is assessing the region of southern Wisconsin and northern Illinois through 2011. ATC is conducting the restudy. ATC completed a stability restudy of the second unit on June 13, 2003. The first report of this restudy which covers the first two SCPC units is expected to be complete in mid-July. The preliminary results clearly indicate that no, new long 345 kV line is required to provide reasonable stability responses for the first two 650 MW SCPC units. (One of the original study solutions for adequate stability was a 345 kV from Pleasant Prairie to Libertyville via Zion.)

The expected results of the restudy, as of June, are summarized below. The detail projects are described in Table 6-10. Some stability performance issues still need to be determined for Phases I and II. The solution possibilities beyond the other transmission lines:

- Another 345 kV breaker line position at Elm Road
- Series breakers at two Pleasant Prairie 345 kV lines
- And either a power system stabilizer on Oak Creek Generator #9 or a restriction on it's operation

The original study had the cost assessed as follows;

Phase I	\$117,711,544
<u>Phase II</u>	<u>\$ 46,338,542</u>
Total	\$164,050,086

The incomplete restudy has the follow estimate:

Phase I	\$ 16,639,391	plus move the 345 kV and 138 kV substations
<u>Phase II</u>	<u>\$ 64,320,789</u>	
Total	\$ 80,960,180	plus move the 345 and 138 kV substations

It has not been estimated when the transmission studies for all three phases will be completed. Another uncertainty factor is the potential retirement of Oak Creek Units 5 and 6 which total 550 MW. That could have a significant influence on the transmission requirements for the third ERGS unit, the IGCC.

**Table 6-7 Estimated costs for Phase 1 Improvements - original study**

Item No.	Project	Projected Cost (\$2007)
<b>System Reinforcements for System Stability (Required)</b>		
1.	Expand Oak Creek 345 kV Switchyard into 10 position breaker and a half design <sup>(a, b)</sup>	17,647,133
2.	Construct Oak Creek – Brookdale 345 kV Line	17,277,670
	a. Construct new line from Oak Creek – Brookdale 345 kV line	
	b. Convert/Reconductor non-operative 230 kV line segment from C&NW RR to St. Martins	
	c. Convert/Reconductor 5 miles of Bluemound-St. Martins 138 kV line (KK5066) from St. Martin Substation to Brookdale site	
3.	Construct Brookdale 345/138 kV Substation with 1,500 MVA 345/137 kV transformer	14,813,630
4.	Construct Brookdale – Granville 345 kV Line	18,196,380
	a. Convert/Reconductor 5.6 miles of Bluemound St. Martins 148 kV line (KK5066) from Brookdale to Bluemound Substation	
	b. Rebuild western lower line from Bluemound to Carmen site and install 7-mile 345 kV line segment	
	c. Convert Carmen to Granville (3 miles) segment of Tamarack Granville 138 kV line (KK3444) to 345 kV	
5.	Install line breaker and termination equipment at Granville 345 kV substation	1,112,000
6.	Convert Oak Creek to Bluemound 230 kV line (K873) to 345 kV	18,983,330
7.	Construct Bluemound 345 kV Substation with 1,500 MVA 345/138 kV Transformer	4,933,164

**PUBLIC SERVICE COMMISSION OF WISCONSIN  
DEPARTMENT OF NATURAL RESOURCES**

Item No.	Project	Projected Cost (\$2007)
<b>System Reinforcements for System Stability (Required)</b>		
8.	Install two series line breakers at Pleasant Prairie Substation <sup>(c)</sup>	2,126,684
<b>Subtotal</b>		<b>95,089,991</b>
<b>System Reinforcements for Short Circuit (Required)</b>		
9.	Replace at Bluemound Substation seven 138 kV overdutied circuit breakers having an interrupting rating of 42 kA with breakers having a interrupting rateing of 63 kA	2,435,391
<b>Subtotal</b>		<b>2,435,301</b>
<b>Total</b>		<b>97,525,382</b>
<b>System Reinforcements for Thermal (Optional)</b>		
10.	Install two breakers and termination equipment at Oak Creek Switchyard 138 kV <sup>(d)</sup>	1,643,377
11.	Construct Oak Creek-St. Martins circuit #2 (Refer 4a) <sup>(d)</sup>	3,276,000
12.	Relay modification St. Martins Substation <sup>(d)</sup>	114,000
13.	Construct Butler to Carmen line segment to form Butler-Tamarack Line (Refer 4c) <sup>(d)</sup>	332,300
14.	Butler Substation (add one line breaker and ancillary equipment ) <sup>(d)</sup>	523,170
15.	Install Bluemound-Butler Line (KK5051) on new 345 kV structures (Refer 4b) <sup>(d)</sup>	582,220
16.	Reconductor Oak Creek-Ramsey 138 kV	138,000
17.	Reconductor underground segment Harbor-Ramsey 138 kV line	11,535,000
18.	Reconductor Oak Creek-Allenton 138 kV	2,034,000
19.	Reconductor Harbor-Norwich-43 <sup>rd</sup> Street 138 kV <sup>(e)</sup>	-----
<b>Total</b>		<b>20,178,067</b>
<b>Grand Total</b>		<b>117,703,449</b>

Notes:

- Includes transfer of unit #7 from 230 kV to 345 kV bus.
- Transmission breakers for unit connections are required for stability purposes in Phase 3. These breakers are not required for stability purposes in this phase and have not been included. However, the additional breakers may be included in Phase 1 pending development of connection standards presently under review.
- Alternate solution is construction of 345 kV ring bus at Bain Substation (\$4,481,132).
- System reinforcements needed to maintain the integrity and thermal capability of transmission system due to facilities converted to 345 kV operation for stability purposes.
- Included in Lakeside retirement project.

**Table 6-8 Estimated costs for Phase 2 improvements - original study**

Item No.	Project	Projected Cost (\$2007)
<b>System Reinforcements for System Stability (Required)</b>		
1.	Install two breakers and termination equipment at Oak Creek 345 kV Switchyard to accommodate second 650 MW unit <sup>(a, b)</sup>	4,211,858
2.	Install 345 kV breaker and termination equipment at Pleasant Prairie Substation	1,063,342
3.	Construct Pleasant Prairie-Libertyville 345 kV line (~ 23 miles). <sup>(d)</sup>	40,000,000
4.	Install 345 kV breaker and terimation equipment-Libertyville Substation (Exelon/CECo)	1,063,342
<b>Subtotal</b>		<b>46,338,542</b>
<b>System Reinforcements for Short Circuit (Required)</b>		
	Replacement of overdutied circuit breakers	0
<b>Subtotal</b>		<b>0</b>
<b>Total</b>		<b>46,338,542</b>
<b>System Reinforcements for Thermal (Optional)</b>		
	No items to be entered <sup>(e)</sup>	0
<b>Total</b>		<b>0</b>
<b>Grand Total</b>		<b>46,338,542</b>

**PUBLIC SERVICE COMMISSION OF WISCONSIN  
DEPARTMENT OF NATURAL RESOURCES**

Notes:

- a. Includes addition of the second 650 MW generating unit.
- b. Transmission breakers for unit connections are required for stability purposes in Phase 3. These breakers are not required for stability purposes in this phase and have not been included. However, the additional breakers may be included in Phase 2 pending development of connection standards presently under review.
- c. Short Circuit Study for Phase 2 did not identify any overdutied circuit breakers.
- d. An alternative line being considered is a Big Bend-Paddock 345 kV Line (\$61,544,474):
  - Construct initial 3-position 345 kV ring-bus at Big Bend Switching Station site (\$4,481,132).
  - Install circuit breaker #4 at Paddock 345 kV ring-bus and termination equipment (\$1,063,342).
  - Construct 56 mile Big Bend-Paddock 345 kV line by rebuilding existing 138 kV ROW with double circuit structures to accommodate existing 138 kV circuits and new 345 kV circuit (\$56,000,000).
- e. The reinforcements identified in the thermal study for Phase 2 are already required in Phase 1 for stability purposes (Refer to Table 6-4).

**Table 6-9 Estimated costs for Phase 3 improvements - original study**

Item No.	Project	Projected Cost (\$2007)
<b>System Reinforcements for System Stability (Required)</b>		
1.	Expand Oak Creek 345 kV Switchyard breaker and a half design to 16 positions. <sup>(a)</sup>	21,880,544
2.	Install three breakers and termination equipment at Oak Creek 138 kV Switchyard. <sup>(b)</sup>	6,848,088
3.	Convert Oak Creek-Bluemound 230 kV line (K862) to 345 kV and reroute line into Arcadian Substation.	28,171,000
4.	Expand Bluemound 345 kV Substation into 7-position ring-bus with 2,500 MVA, 345/138 kV transformers.	17,194,478
5.	Install two 345 kV circuit breakers and termination equipment at Arcadian Substation.	5,568,096
6.	Convert Oak Creek-Racine 138 kV line to 345 kV to create second Oak Creek-Racine 345 circuit.	7,036,000
7.	Install 345 kV circuit breaker and termination equipment at Racine Substation.	1,112,000
<b>Subtotal</b>		<b>87,810,206</b>
<b>System Reinforcements for Short Circuit (Required)</b>		
8.	Replace a total of 22-138 kV overdutied circuit breakers at Harbor, Everett, and Haymarket Substations having an interrupting rating of 50 kA with breakers of 63 kA. <sup>(d)</sup>	7,654,086
<b>Subtotal</b>		<b>7,654,086</b>
<b>Total</b>		<b>95,464,292</b>
<b>System Reinforcements for Thermal (Optional)</b>		
9.	Install two 500 MVA 345/138 kV transformers at Arcadian Substation	55,700,370
<b>Total</b>		<b>55,700,370</b>
<b>Grand Total</b>		<b>151,164,662</b>

Notes:

- a. Includes the transfer of unit 8 from the 280 kV to the 345 kV bus. Includes seven transmission breakers for unit connection plus one line connection required for stability purposes.
- b. Includes the transfer of units 6 and 9 from the 230 kV to the 138 kV bus.
- c. Includes re-route of Brookdale-Granville into Bluemound Substation.
- d. Except for the one project listed here all reinforcements identified in the thermal study for Phase 3 are already identified and required for stability purposes for Phase 3.

**Table 6-10 Estimated costs for restudied improvements associated with the ERGS project**

<b>Item No.</b>	<b>Restudy Projects</b>	<b>Projected Cost (\$ 2007)</b>
	Not detailed by type or requirement	
RI.1	Replace and relocate Oak Creek 345 kV 5 position ring bus with new Elm Road 4 section, 8 position, conventional breaker-and-half	Not completed
RI.2	Replace and relocate Oak Creek 138 kV 9 section, 12 position, inverted breaker-and-half, with new Elm Road 8 section, 13 position, inverted breaker-and-half	Not completed
RI.3	Reconductor Oak Creek – Ramsey6 138 kV (0.8 mile)	135,000
RI.4	Reconductor Oak Creek - Allenton 138 kV (5.4 miles)	2,034,00
RI.5	Reconductor underground segment Harbor – Ramsey5 138 kV (5.7 miles)	11,535,000
RI.6	Replace at Bluemound substation 7 – 138 kV overdutied circuit breakers having an interrupting rating of 42 kA with breakers with an interrupting rating of 63 kA	2,435,391
	Subtotal Phase I	<b>16,139,391</b> w/o RI.1 & RI.2
RII.1	Install bus section with three breakers and termination equipment at Elm Road 345 kV for second 650 MW unit and one 345 kV line	4,211,858
RII.2	Add line position (2 circuit breakers) to Oak Creek 138 kV inverted breaker-and-half bus design	1,643,337
RII.3	Construct Oak Creek – Brookdale 345 kV line (25.1 miles)	17,277,670
RII.4	Construct Brookdale – Granville 345 kV line (16.6 miles)	18,196,380
RII.5	Build Brookdale 345 & 138 kV substation including 3 position 345 kV ring bus with single 500 MVA 345/138 kV step down transformer and initial 2 section, 8 position 138 kV radial bus	14,813,630
RII.6	Install 345 kV line breakers and termination equipment at Granville substation	1,113,000
RII.7	Construct Oak Creek – St. Martins 138 kV line (17.3 miles)	3,276,000
RII.8	Construct Butler – Carmen 138 kV line segment to form Butler – Tamarack (1.6 miles)	443,400
RII.9	Install Bluemound – Butler line (KK5051) on new 345 kV structures (5.4 miles)(Reference RI.4)	582,220
RII.10	Add line breakers and ancillary equipment at Butler substation	523,170
RII.11	Add two - series line breakers at Pleasant Prairie substation	2,126,684
RII.12	Relay modifications at St. Martins substation	114,000
	Subtotal Restudy Phase II - Preliminary	<b>64,321,349</b>
	Total for Phase I and II (w/o RI.1 & RI.2)	<b>80,460,740</b>